AMERICAN RAILROAD JOURNAL

NEW YORK [ETC.]

V. 11, 1840

G. A. Nicolls.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

VOL. V.—NEW SERIES,
OR
VOL. XI.

New-York:
PUBLISHED BY THE EDITORS AND PROPRIETORS,
GEORGE C. SCHAEFFER, AND EGBERT HEDGE.
120 *Nassau-st.* (*Up stairs.*)

1840.

INDEX.

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 1, Vol. V. New Series.	JULY 1, 1840.	Whole No. 361. Vol. XI.

METEOROLOGICAL OBSERVATIONS.

In returning thanks to our correspondents, for their various favors in the last volume of the Journal, by some strange oversight, we omitted to mention our esteemed friend *P. G. Voorhees*, whose valuable tables have been continued regularly ever since the commencement of this work. This gentleman has not only conferred a favor upon us, but has merited the thanks of the scientific world, for his perseverance in continuing observations which are, as far as we know, the only ones upon which any accurate deductions of the mean annual temperature of that vicinity can be based. It is highly important to ascertain whether there are any changes in this mean, and if so, what their character and amount is. We should be delighted to find other gentlemen in the more remote portions of the United States, following up a similar plan.

While we are on this subject, we beg leave to make a few remarks upon a topic of much interest. We refer to the duty which we consider incumbent on civil and military Engineers to engage in systematic and accurate meteorological observations it is very certain that there is no class of men so well suited to the performance of this duty, whether we consider their general distribution over the country, or their peculiar adaptation by reason of their previous education and training. As good observers, civil Engineers stand unrivalled. They are better able to endure the peculiar fatigue arising from long continued exertions of this kind, and in this country at least, they are generally accustomed to great accuracy in the use of their instruments.

Our general government, aware of the advantages to be derived from observations over the wholee xtent of our country, has employed M. Nicollet to prepare for the use of the officers of the army and navy, instructions for this purpose. These are in their way very good, and could a sufficient number be distributed among the civil Engineers of the United States, much good might result.

It is not to be expected that many individuals should engage in the most complete series of observations—yet each one has his peculiar province in which to collect useful facts.

Those who are resident upon our great lakes or rivers, can with but little trouble to themselves, obtain the most valuable results, by comparing the rise and fall with the temperature, quantity of rain, and rate of evaporation, or dew point. Annual tables of this description would lead to practical applications of extended utility.

The mean annual temperature of any one place as obtained with a very trifling exertion of attention and expense of time is datum exceedingly necessary to the most advantageous construction of all works in which iron is extensively employed. The almost entire destruction of the stability of a railroad, can be occasioned by a very trifling oversight in this respect. This indeed, is only one of many professional applications of meteorological science, which would seem to invite Engineers into this fruitful field of observation.

In England, Col. Ried has drawn attention to the subject, and engaged the Royal Engineers in the cause. Our seaboard inhabitants have ample means for testing these theories of storms, but we are almost without data for ascertaining the laws which regulate the atmospheric currents, in the "far west." That these are in a manner similar to those which circulate over the Atlantic there can be but little doubt, still the great changes and deflections produced by obstacles, attaining a considerable elevation in the centre of a large continent, must produce results which cannot be anticipated, and yet remains to be developed from observation.

Barometrical observations are in many cases practicable, and in their result of extreme utility. We wish that our friend Voorhees would add a barometer to his other instruments, and thus more than double the value of his tables.

It is certain that the barometer may be employed, when in the hands of one thoroughly acquainted with the instrument—as a rapid and economical means of obtaining approximate elevations in situations remote, either in distance or elevation, from any point of a carefully levelled line. For ascertaining the lowest pass of an extensive ridge, the barometer affords a far more expeditious and more eligible mode than the level. We are convinced that this instrument has been too much neglected by Engineers, and is capable of far greater accuracy than is commonly imagined.

The fluctuations of the dew point are also of much utility in the construction of canals, and have in connection with the observations on the rain gauge received some attention from Engineers, but far less than they really deserve.

Without entering into further details, we may remark that the plan of taking meteorological observations simultaneously, on certain days, deserves the attention of our Engineers; several persons have taken the mat-

ter up, in the United States, but nothing like the general co-operation desir-has yet taken place.

We throw out these hints for the purpose of drawing attention, and at any time shall feel happy to communicate any information that may be desired.

For the American Railroad Journal, and Mechanics' Magazine.

METEOROLOGICAL RECORD FOR THE MONTHS OF MARCH and APRIL, 1840.

Kept on Red River, below Alexandria, La., (*Lat.* 31.10 *N.*, *Long.*, 91.59 *W.*)

1840	Thermometer.					REMARKS.
Mar	Morn.	Noon.	Night.	Wind.	Weath.	
1	64	62	62	SE	cloudy	rain in the evening
2	64	66	62	calm	clear	
4	58	68	64	NW	..	
4	56	72	76	calm	..	Red river rising
5	56	72	74	..	..	
6	58	76	74	..	..	
7	62	76	76	SW	..	
8	63	82	78	S	..	
9	66	70	72	SE	cloudy	showers in the evening, with heavy distant [thunder
10	58	68	64	NW	clear	
11	56	66	64	..	..	
12	54	64	60	..	..	
13	52	66	62	..	..	
14	58	70	68	SE	cloudy	heavy thunder showers in the evening
15	68	76	72	..	..	showers through the night
16	70	76	74	calm	clear	
17	70	74	70	..	cloudy	showers all day
18	70	78	72	S	clear	
19	72	82	80	calm	..	
20	60	54	50	NW	..	
21	49	53	48	..	..	
22	46	50	46	N	cloudy	
23	52	54	48	..	clear	
24	44	52	58	W high	cloudy	rain and hail in the evening, wind high all night
25	46	48	44	..	..	rain in the evening
26	46	50	43	N	clear	
27	63	74	68	calm	cloudy	
28	69	72	71	..	..	
29	62	68	63	S	..	rain all day
30	68	70	65	calm	clear	
31	44	58	56	W	..	white frost
	59	67	64	....	....	mean temp. of the month 63.3
Apr.						
1	50	60	59	NE	cloudy	light rain
2	56	60	59	calm	..	
3	60	62	63	..	..	heavy thunder and rain in the morning
4	66	68	70	S	..	foggy morning light shower all day
5	68	72	72	..	..	foggy morning
6	69	76	78	..	clear	
7	64	72	72	SW	..	heavy thunder shower in the morn'g clear day
8	60	69	66	NW	..	
9	60	69	69	calm	..	
10	66	72	71	SE	cloudy	thunder showers in the night
11	67	78	74	SW	..	
12	70	70	66	..	clear	light showers in the morning clear day
13	60	71	70	SE	cloudy	morning clear day
14	70	81	78	calm	clear	
15	70	72	73	..	cloudy	heavy thunder showers morning and forenoon
16	69	80	79	S	clear	foggy morning, clear day [evening clear
17	72	79	78	S high	cloudy	morning, clear day
18	72	80	74	SW	..	heavy thunder W to N, no rain
19	68	68	67	NE	..	heavy thunder in the morn'g, no rain, thunder shower in the evening
20	64	76	76	SE	clear	
21	68	86	80	calm	..	
22	70	86	80	S high	..	
23	74	86	80	..	..	
24	76	86	80	S light	cloudy	morning, clear day
25	74	87	82	..	..	"
26	70	80	75	N	clear	light showers at noon
27	64	78	70	NE	..	heavy thunder in the S W, no rain
28	66	84	70	calm	cloudy	light thunder shower from S W
29	72	82	76	..	clear	thunder shower in the morning, clear day
30	72	87	82	SW	..	lightning in the north at night
	67	76	73	....	....	mean temp. of the month, 73.

To the Editors of the American Railroad Journal, and Mechanics' Magazine.

GENTLEMEN:—In your last number, I perceive the crank is again a subject of discussion. I have hitherto trenched upon this subject, only so far as it was connected with my "true (and I may add new) expression of the powers of locomotive engines"—as developed in several papers published in the Journal.

I felt myself particularly called upon, to illustrate and define the effect of the crank, when recently it was attempted to account for the deviations of De Pambour's formula from experience, by an absurd estimate of the actual loss, at variance with the implications of my expression. I might on that occasion have put aside the question, with the single remark, that its effect was included with the utmost precision in the item "friction," which had been determined accurately by experiment; but for the sake of illustrating the long mooted principle of crank motion, in a new mode, not liable to the objection of error, from fallacious reasoning upon absurd premises, I chose to dilate more largely than was strictly required of me, and to deduce the amount of loss from experiment alone.

As observed in setting out, the subject has again come up, in such a way as to require from me, some attention. I must, however, throw myself upon reserved privileges in future—being indisposed to run a tilt Quixotic after every errant and gratuitous assertion relating to this subject—as an attentive perusal of the accomplished Engineer, will satisfy him of the correctness of my previous investigations.

Your correspondent observes, "that three of your correspondents have lately assumed positions respecting the crank, that if proved, would annihilate the whole theory of mechanics, and lead directly to perpetual motion," and quotes my remark that "the force in passing from its primitive direction, to its final direction in the tangent to the rotary circle of the crank, must evidently lose two proportions," etc.

All the verbal sophistry employed by Mr. Aycrigg, in convincing himself of the tendency he has asserted, need not be examined; and his demonstration of the nullity of loss of effect (which I presume he finds necessary to support the vagary of a perpetuum mobile into which he had sophisticated himself) may be controverted in a very few remarks, and with very little difficulty. For either very little skill or very little caution could have led him to assume as the *basis of all he has said or done*, the profound absurdity of making a *component* of two rectangular forces coincident with the *resultant*; that is, when resolving the force, in making $p = P$ sec. d, instead of $p = P$ cosin. d.

For in that way it is quite evident that the force of the piston would become a much more wonderful affair than even a perpetual motion—since when the angle d is near a right angle, the force upon the piston would be *multiplied to an unlimited extent*; and by combining several connecting rods, changing the direction of the force at each, according to this postulate, a power quite unlimited might be *created*; and an animalcule might

be substituted for the gigantic power which men have hitherto found it necessary to employ. All this is of course chimerical, and the result of incorrect analysis—since p, on the contrary, *is diminished by means of the connecting rod,* in proportion to the cos. of the angle d; and, so far from ever exceeding the force upon the piston to an infinite degree, is always less than it, except (for an instant) at the commencement of the stroke—when they are equivalents, and p has its greatest possible value.

It would suffice to add that this incautious assumption is the *basis of all the inferences and apprehensions* of Mr. A. Of course the "castles airy," which he has been at the trouble of erecting, tumble into a promiscuous chaos of cloud and vapor; but as the principle of virtual velocity has been violated equally in the proportion

$$V : v :: \sin. c : R$$

which is another part of his demonstration, it may be adduced as a matter which would equally overthrow the whole fabric.

Mr. Aycrigg observes in conclusion, "one of the gentlemen whose words I have quoted, refers to defects in De Pambour's formula, and shows that a uniform loss from the crank, will not remove the difficulty."

"I will add (he continues) that if we reject the formula and take the experiments, we will find in them a proof that there is no loss from the crank."

To the first of these observations I cannot object. But the last, the reader of my paper can hardly, I should think, fail to perceive to be mere assertion; since what Mr. A. terms "calculations," are purely *numerical statements* of the *results of experiment,* having no connection whatever with De Pambour's formula, or any other. It would be just as proper to say, that on determining by experiment any two pressures of steam, that the numbers expressing the degrees of pressure were "calculations," as that the statements referred to were so. Indeed, as has been remarked, I had, on the face of my paper, disclaimed all other modes of investigation but experimental.

It will be understood that my determination of the loss of effect from crank motion agrees as little with the other determinations quoted by Mr. A., as it does with his own. I mention this, that I may not be understood as vindicating any but my own investigations.

Very respectfully yours,

WM. MC C. CUSHMAN.

Albany, 11*th June,* 1840. *Civil Engineer.*

P. S.—An obscurity has been created in the paper upon the crank, by an error or two of the press, which may be corrected on this occasion. The original reading was "bear some constant relation to the power expended, or the total resistance," instead "*be on* some constant relation to the power expended *on* the total resistance;" and in another place, "the resistance of an unloaded engine," instead of "this resistance," etc.

W. MC C. C.

For the American Railroad Journal, and Mechanics' Magazine.

FARMINGTON AND HAMPSHIRE AND HAMDEN CANALS.

In the last number of the Journal, is a communication on the subject of the Farmington and Hampshire and Hamden canals, in which the writer recommends that the canal be converted into a site for a railway, as being the best disposition that can now be made of that work. That the canal has proved a complete failure is well known, the revenue upon it being entirely inadequate to keep it in repair. And it is also quite evident that the modicum of aid which it has recently received from the city of New Haven, can have no other effect but to prolong for a very limited period its frail existence. It will be recollected that when this canal was projected it was intended as a rival to the project of improving the Connecticut river. Our object in inviting the attention of the readers of the Journal to the subject at the present time, is to remind them of a communication from the pen of E. F. Johnson, Esq., Civil Engineer, addressed to those interested in the work, more than twelve years since, in which the two projects are compared somewhat in detail, and results predicted which have since transpired to the letter.

Mr. J. exposes in the first place the fallacy of the principle, with which the minds of leading men were at that time strongly imbued *that it was better in most, if not all cases, to construct an independent canal, than to endeavor to improve the channel of a river.* This was then, as Mr. J. stated "the generally received opinion with the Engineers in the Old Countries, particularly in England," and so firmly persuaded was the celebrated Engineer Brindley of the correctness of the opinion, that he would not allow that rivers were useful for any other purpose than to "feed navigable canals,"

The reasons assigned for this opinion, were

1st A diminution of the distance as compared with the rivers.

2d A saving in expense or a better navigation at a nearly equal expense.

3d A saving in time, there being less delay and more certainty, with no more lockage on the canals than upon the rivers.

Mr. J. remarked that these reasons, although entitled to much weight when applied to a country like Great Britain, owing to the limited size of the rivers, and their serpentine character, and the state of the sciences and the arts in that country at the time the question of inland navigation was most discussed, were not applicable to the case under consideration, and for the follwing general reasons.

1st The distance to tide-water was considerably less by the river than by the proposed canal.

2d A great saving in lockage by the river, there being full ten times as many locks upon the canal as upon the river.

3d The magnitude of the river exceeding that of the English rivers, permitting the use of steam to advantage, a species of power more economical under the circumstances than that of horses on the canal, and less un-

derstood at the time in its application to river navigation in England than in the United States.

4th A saving in the entire cost of a towing path on the bank of the river above the reach of floods; an improvement which was indispensable on the English rivers.

5th The population being the greatest, and the business of the country having already centered to a very considerable extent upon the banks of the river, it would not be easy to divert it from its accustomed channel.

6th The lumber which formed the greater portion of the tonnage of the Connecticut river valley would continue, owing to the cheaper mode of transit and expense of transferring to canal boats, to be floated down upon the river.

7th. The greater speed attainable upon the river with steam as a propelling power; being probably double or treble that upon the canal.

The above with various other reasons were adduced by Mr. J. as conclusive in his own mind, in respect to the impolicy of constructing the canal. The advocates of the project, firm in the belief of the superiority of a canal to river navigation, and stimulated by the extraordinary success which attended the first opening of the Erie canal, and encouraged by the opinion of Clinton, that the Farmington canal would eventually be to New Haven what the Erie canal was to Albany, became so deeply enamored of the project, as to be beyond the reach of argument, and no reasons, however cogent, could be urged to induce an abandonment of the undertaking.

The result is now known, and it were a painful task to enumerate the suffering produced by the hundreds of thousands of dollars lost to its proprietors and to the world forever, unless the labor expended can be appropriated to some profitable use, (a railway for instance,) as suggested in the paper to which we referred at the beginning of this article.

It is worthy of notice that the canal has proved a total failure, notwithstanding the improvement of the river for the use of steam, has not been carried higher up than Springfield, 16 miles below the point where the canal leaves the river. This again fully confirms the opinion advanced by Mr. J. in the communication referred to, which we quote as follows, in his own words. He says:

"Without wishing to arrogate to ourselves any thing like superior wisdom, we will venture to affirm, that *if the construction of the canal were made a question of expediency, without any reference to the rival project of improving the river, it could not be answered in a manner sufficiently satisfactory to warrant engaging in its execution.*"

It was in the same year or shortly after, the publication of the above communication of Mr. Johnson, that he presented his views in a general form as to the relative merits of railroads and canals, while discussing the importance of a railway communication leading from New York city to the Mississippi valley, and in which he arrived at the conclusion, that "*railways as a means of inter-communication, possess properties which in many*

situations will render them superior to canals, and that with reference to the United States, considering how diversified it is with hills and vallies, railways when properly constructed will be found the most valuable and effective, and *that ultimately when their merits become better known and more fally appreciated, by far the greater portion of the inland traffic and travel will be conducted upon them.*"

The truth of this prediction, is daily becoming more and more manifest, and in no instance, perhaps, is it forced upon the mind in a stronger light than in the case of the Farmington canal as compared with the New Haven and Hartford railroad, the one of little comparative value to the community, a curse instead of a blessing to its proprietors, and on the verge of being abandoned—the other rapidly taking rank among the great great leading thoroughfares of the country.

SMEATON.

Can any of our friends us furnish with a correct statement of the arrangement of the grades and curves upon the Housatonic railroad, from Bridgport to the north line of Connecticut? We should like also, a similar statement, relative to the continuation of that line to West Stockbridge in Massachusetts.

We extract the following useful tables from Mr. C. Ellet's report on a suspension bridge over the Mississippi, at St. Louis. We shall have occasion again to notice this report.

TABLE OF THE TENACITY OF BAR IRON AS GIVEN BY DIFFERENT EXPERIMENTERS.

Names of experimenters.	OBSERVATIONS.	Cohesion per square inch.
		TONS.
Perronet.	On bars about 1-2 inch square. Mean of 11 experiments.	27.0
do.	On round bars 2-5 inch diameter. Mean of 11 experiments.	26.6
Soufflot and Rondelet.	On bars 1-6 of an inch to 1-2 inch square. Mean of 16 experiments.	29.5
Poleni.	On bars about 1-10 of an inch square.	28.0
Telford.	On bars of Welsh, Swedish and Staffordshire iron, from 1 to 2 inches in diameter. Mean of 9 experiments.	29.3
Brown.	On bars of Welsh, Swedish and Russia iron, from 1 to 2 inches in diameter. Mean of 8 experiments.	25.0
Barlow.	On bars of medium quality, 1 inch. Mean of 4 experiments.	25.2
Brunel.	On Yorkshire iron of first quality, from 3-8 to 1-2 in. square. Mean of 10 experiments.	32.8
do.	On Yorkshire iron of second quality, of the same size.—Mean of 10 experiments.	30.8
Seguin.	Small bars of French iron. Mean of 9 experiments.	27.6
	Mean of all the preceding results,	28.2

TABLE OF THE ULTIMATE STRENGTH OF IRON WIRE AS OBTAINED BY DIFFERENT OBSERVERS.

Names of experimenters.	OBSERVATIONS.	Cohesion per square inch.
		TONS.
Seguin.	On wire varying from 1-120 to 1-4 of an inch in diameter. Mean of 25 experiments.	44.2
Dufour.	On wires of different sizes—from 1-30 to 1-8 of an in. diam.	41.5
Telford.	On wires from 1-16 to 1-5 inch in diam. "*These wires all broke at joints or unsound places.*"	38.4
Chaley.	On wire about 1-100 of a foot in diam. used in the construction of the Freibourg Bridge.	51.7
	Mean of all the preceding results,	44 tons.

Williams' Register, we understand, will soon be ready for delivery, replete, as usual, with interesting statistical information. We are favored with the following condensed view of the railroads of this State, prepared for that valuable work.

RAILROADS IN THE STATE OF NEW YORK.

From the peculiar formation, and situation of the State of New York, she is the best located of any State, between the upper lakes and the Atlantic Ocean, to be benefitted by a well digested system of railways. The natural breakwater of Long Island gives to New York the best harbor on the sea board, with the advantage of two outlets to the ocean, at all seasons of the year, for the largest class of vessels.

The Hudson river, and its tributary, the Mohawk, are the only streams that penetrate the Apalachian ridge. These mountains under different names, extend from the northwest part of the State of Georgia, to the northeast angle of the State of Maine. The lowest summit of this ridge is at Rome, Oneida Co., N. Y., 425 feet above tide-water. At Rome, the waters unite at the old Indian portage, in the Erie canal, and then divide for the ocean. The outlet in the direction of the St. Lawrence valley, is by Wood and Fish creeks, the Oneida lake and river, and the Oswego river to lake Ontario at Oswego. One of the advantages of the route through this State is that the distance is only 168 miles from tide-waters at Albany to the upper lakes at Oswego. It now requires the construction of but 35 miles of railway, from Syracuse to Oswego, to complete this line by railways to the west.

With the addition of 150 miles from the line of the Oswego railway along the ridge road, the important port of Buffalo may be reached with a gradual rise of 140 feet from the Rome level, thus favoring the descending trade to the Hudson, with an average of less than 2 feet to the mile.

To reach lake Erie from Boston, by the *Massachusetts "Western railroad,"* via. Worcester, Springfield, Pittsfield and Stockbridge, and from thence by Albany and the valley of the Mohawk, the distance is 517 miles. The grades in Massachusetts to enter this State at the Cannon Gap, run up to 80 feet in the mile, to pass the summit (1440 feet,) near Pittsfield. This road is in operation from Boston to Springfield, on the Connecticut river; from that point to the State line of New York, it is under contract, and will be completed by the spring of 1841. From the long wharf in Boston to the Hudson river, this line of railway will cost $6,500,000. The State of Massachusetts has loaned its credit for $3,300,000, towards the prompt completion of the Western railway, to perfect the long desired object of Boston—a direct trade to the west, through the valley of the Mohawk, to exchange her manufactures, oil and fish, for our breadstuffs, provisions, including the whole trade of the west. The great distance from Philadelphia to the ocean, by the Delaware river and bay, with the obstructions by ice, has made that place tributary to New York, since the construction of the Camden and Amboy railroad. The amount Philadelphia has paid us as factors and importers, for an early selection of our goods, has been amply made up to her, by the fostering care of her legislators to secure a line of railroads and canals to the valley of the Ohio. This line has to pass the Allegany mountains at Hollidaysburg, with ten inclined planes, on each side of the ridge, at an altitude of 2397 feet above tide waters.

With this difficult and mixed line of railways and canals, the State of Pennsylvania takes a large share of the early transportation from New York, and Philadelphia has the advantage of the sales of a large amount

that should be made in the city of New York. A barrel of flour costs (1840) $1 55 transportation from the Ohio river to Philadelphia, the bounty of twenty cents paid by the State taken into consideration. The railway from Baltimore through Maryland to Wheeling, on the Ohio, has to surmount an elevation of about 2500 feet; neither the line by Baltimore or Philadelphia, can successfully compete with the southern and northern railways of New York.

The southern or New York and Erie railroad, starts from Tappan, now called Piermont, on the Hudson river, 25 miles from the city hall; it passes through the southern tier of counties by Goshen, Binghamton, Owego, Elmira, and Olean to Dunkirk, on lake Erie. The distance by Judge Wright's report, to Dunkirk is 508 miles. The grading at each termination of the road is under contract, and nearly completed; there are under contract 222 miles, on the following parts of the road; Hudson river to Middletown, Orange co., 55 miles—section on the Delaware, 40—Binghamton to Hornellsville, 117—western termination, 10. The grades since the first surveys, have been reduced to 60 feet to the mile, and the distance shortened 25 miles, by a survey made by E. F. Johnson, Esq. The inclined planes at the Hudson river and lake Erie, have been dispensed with, and the line much improved by recent surveys. The importance of this railroad to the southern tier of counties, is easily seen, when it is taken into consideration that it will connect the city of New York with the coal and iron regions of Pennsylvania; with the Allegany river at Olean point, and with the Genesee valley canal at Olean point, also the Chenango canal at Binghamton. This road is advantageous to the State, to develope the resources of a rich agricultural and dairy district, with one unbroken line, and under one charter, from Piermont (or Tappan) on the Hudson river to Dunkirk, on lake Erie. The cost for a single track, owing to the cheapness of lumber, and other favorable circumstanses, may be estimated at $6,000,000. The State passed a law in 1837, to furnish $3,000,000 towards the construction of this road, in the ratio of dollar for dollar—as the company expended $100,000, they are entitled to receive a like sum from the State. Under this law they have received $400,000. A law has passed the present legislature, to grant the company in the proportion of $2 for $1, they shall expend in its construction, on the pledge of the road as security, for the interest and principal of the loan.

The northern or middle line of railway to connect the city of New York with Buffalo, in one unbroken chain, from the city hall, by Albany, Troy, Utica, Syracuse, Auburn Rochester and Batavia, consists of 9 separate companies. A short sketch of the several companies, will convince the most skeptical, that there is no route from the seaboard to the vallies of the St. Lawrence and Mississippi, that can compete with this line, when it is stated that from Buffalo to Albany, it gradually descends to the Hudson river, at the average rate of 2 feet to the mile. From Albany to New York the road passes through the eastern parts of the counties of Rensselaer, Columbia, Dutchess, Putnam and Westchester, to the Harlem river, with no grade on the whole distance to exceed 30 feet to the mile. The summit east of the Hudson is situated in the town of North East, in Dutchess co., 25 miles from the Hudson. At this point it is 769 feet above tide water. This is less by 300 feet than the lowest summit from the Atlantic to the vallies of the St. Lawrence and the Ohio, with the exception of the passes through the Highlands and at Little Falls, by the Hudson and Mohawk rivers. It has been previously stated, that on this line west of the Hudson river, that the elevation at Buffalo (with no great intervening obstacles) is 565 feet above tide waters. It is estimated that trains of 200 tons of goods

can be carried over this road, at the rate of 10 miles per hour, with the same ease that 101 cars have beeg drawn by one engine, over the Philadelphia and Reading railroad, loaded with 307 tons of goods nett, (exclusive of cars engine and tender,) at the same rate of speed.

The roads on the northern line, under the several charters, are as follows: The New York and Harlem railroad Co., was chartered 1831: the road is 7¾ miles long from the city hall to the free bridge over the Harlem river. At this point it is designed to connect this road with the New York and Albany railroad. The Harlem company after encountering many difficulties have completed a double track nearly the whole distance to the bridge on the Harlem river, at the end of the 4th Avenue. The company has overcome obstacles in rock excavations, tunneling, and embankments, unequalled by any road in this country, or in Europe, for the same distance. The two tracks with depots, fixtures and motive powers, it is stated, have cost $1,100,000.

The receipts for the year ending the 1st April, 1840, were $104,501 50.

Since its completion, 3,810,000 passengers have passed over it, to the great accommodation of the public. The officers of the company are

Sam'l. R. Brooks, *Pres't.*	Thos. A. Emmet, *Vice Pres't.*
Thos. Sargeant,	Isaac Gibson,
Samuel Meredith,	William P. Hallett,
Shepherd Knapp,	David Banks,
Henry Erben,	Henry Yates,
John V. Greenfield,	John Ward, *Directors.*

The charter of the New York and Albany railroad was granted in 1832 and the compauy was organized in 1838, with the following directors:

Chas. H. Hall, *Pres't.*	Jacob Harvey
Jonathan P. Hall,	Isaac Adriance,
John Harris,	Jacob T. Merritt,
Lewis G. Morris,	Fras. Barretto,
Jos. W. Tomkins,	Jonathan A. Taber,
Jonathan Aikin,	Gouverneur Morris,
Benjamin Wright,	Jos. E. Bloomfield, *Commissioner.*

The recent surveys of this railroad, made under the direction of the Commissioner, Jos. E. Bloomfield, have resulted in the discovery of a route entirely within our own State, on which no inclined plane, or tunnel is necessary. The spur of hills or branch from the Highlands, extending into Vermont, is passed by a remarkable level valley, formed by the Croton river, the Oblong and Clive creeks; with no grade from the Harlem river to Albany that exceeds 30 feet to the mile, and it is remarkable that the distance from the city hall to Albany, 147 miles and 71 chains is less than by the Hudson river.

There are two summits, one in Westchester, the other in Dutchess co. 769 feet above tide water. Proposals have been made to the company to construct this road in thirty months, (exclusive of right of way ceded to a great extent,) for the sum of $2,450,000 including 10 engines and cars to operate the road. The first section has been put under contract up to Williams' bridge in Westchester at less than this average per mile.

The next link in the line is the *Mohawk and Hudson railroad*, extending from Albany to Schenectady 15⅞ miles. This road was one of our first experiments, and cost $1,100,000, upwards of $70,000 per mile for a double track; it has two inclined planes, entirely unnecessary. These will be dispensed with, as well as on the new road the city of Troy proposes to build from their railroad bridge over the Hudson at Troy to Sche-

nectady. The distance 15 miles, and no grade to exceed 60 feet, to descend to the Hudson. From Schenectady to Utica, the distance is 78 miles. This road owing to its being located by law on the north side of the Mohawk has cost $1,540,000 for a single track, with 20 miles turnout in the centre; it now divides 12 per cent. per annum, with a yearly increasing surplus. This income is derived from passengers and conveying the United States mail. By a singular policy of the State, this road has been confined to the transportation of passengers, although the public have repeatedly petitioned to the legislature to permit the company to carry freight, paying therefor, into the State treasury the same tolls as charged on the Erie canal. The company have finally been permitted to carry extra baggage, for passengers, provided no charge is made therefor by the company.

The variety of manufactured cotton and woollen goods in Oneida co., and on the route, with the raw material of cotton from the new crop, required from the seaboard, after the closing of the Erie canal, renders it very desirable that this *Utica and Schenectady railroad Company*, should have permission to carry freight on paying canal tolls to the State Treasury and thus greatly accommodate the public. It can be no injury to the trade on the Erie canal, or the revenue of the State, but will tend to relieve it, at its most crowded point.

The Utica and Syracuse railroad, next in order, is 53 miles long with a single track built partly on piles; it has cost $900,000. From its completion with a single track, (July 3d, 1829) to the 1st. Jan. 1840 this road received from passengers and the U. S. Mails $117,614 and has realized a nett revenue for the first six months of 10 per cent. A charter has been granted to construct, a *railroad from Syracuse to Oswego* on Lake Ontario, a distance, with easy grades, of 35 miles. This road has been surveyed during the last season and it has the advantage (to travellers to Queenston, Lewiston and Kingston) of affording them an opportunity of sleeping in the Steamboats on Lake Ontario. On the construction of the "Western railroad" through Upper Canada from Hamilton to the Thames river and Detroit, this line of railways and Lake navigation will be an important thorughfare to the west and north west with rest at night in steamboat.

The main road is completed from *Syracuse to Auburn* a distance of 26 miles at the cost of $460,000; it is considered one of the best on the line and is productive to its stockholders. *The Auburn and Rochester railroad*, passes some distance south of the Erie canal, through the flourishing villages of Geneva and Canandaigua a distance of 77 1-2 miles. This line is represented as 24 miles longer than the route through Lyons.

Thirty miles of the road, between Rochester and Canandaigua will be graded this year. The road is estimated to cost $1,250,000 and with the aid of the State the whole line may be completed at the close of the year 1841; it passes through a rich Agricultural district; the granary of the State of New York.

The *Tonawanda* (*or Rochester and Batavia*) railroad has been finished to Batavia, at an expense of $400,000 for 33 miles. Attica lies south of Batavia 11 miles, thence to Buffalo the distance is 30 miles. A charter has been obtained to make a road from Attica to Batavia. From Batavia to Buffalo by the direct route the distance is 34 miles. This line, from Rochester to Buffalo, 67 miles, is so near a straight line that it only diverges ¾ of a mile to pass by Batavia. The ground for the construction of this road to Buffalo has been granted (from Batavia to Buffalo) to an enterprising company. They have surveyed and located it with the intention of completing it as soon as the Auburn and Rochester railroad is finished.

From this view it will be perceived that the *Northern Line* of railroads

from the City Hall New York, to Buffalo, can be located near the Erie canal, on a very *level route*, with a distance not to exceed 440 miles, and if extended from Buffalo to Dunkirk, (40 miles, for which a charter has been granted,) the distance will not exceed 480 miles. Off from the main line we have the *Buffalo and Niagara* railroad extending from Buffalo by Black Rock to Niagara Falls, 23 miles, at the cost for a single track on wood, of $110,000. The *Lockport and Niagara Falls* railroad extends from Niagara Falls by Wheatfield and Cambria to Lockport, distance 20 miles, capital $175,000. The *Rochester* railroad descends from Rochester on the east bank of the Genesee River 255 feet to the port at the mouth of the river—cost $30,000.

In addition to the above we have the *Rensselaer and Saratoga* railroad (from Troy to Saratoga) distance 21 1-2 miles, cost $450,000. The *Schenectady and Saratoga* railroad distance 23 1-2 miles cost $277,237 for a single track. Both these roads have been in successful operation for several years. An extension of this line has been surveyed and located from Saratoga to Whitehall, distance 43 miles, to connect with Lake Champlain.

A report has been made to the present Legislature 1840 to extend the Troy and Saratoga railroad to the sources of the Hudson river,(in the place of a canal,) thence by *Long Lake and Racket river* to Ogdensburgh.

This road will open for sale 500,000 acres of land, belonging to the School Fund.

The *Ogdensburgh and Chanplain* railroad by Malone and Plattsburgh has been surveyed by Edwin F. Johnson Esq. under the direction of a law of the State. The length is 122 miles, estimated cost $1,451,805. There is another line for the same road, with nearly the same distance examined by Mr. Johnson by the river Au Sable, less exposed to the frontier.

The foregoing presents the *three great lines of* railroads, introduced by Gov. Seward in his first message to the Legislature, as important to connect the vallies of the Mississippi and St. Lawrence with the city of New York. Indivdual enterprise by the *Brooklyn* and *Long Island* railroad Companies has constructed a railroad on Long Island from Brooklyn, by Jamaica, to Hicksville, distance 27 miles at a cost of about $800,000.

This road is designed to connect the city of New York (by Greenport, at the east end of the Island, thence by the Sound and Stonington railroad) with Boston.

The following are the detached railways from the main lines, completed and in the course of construction, in addition to those already named.

The *Catskill and Canajoharie* railroad is 78 miles long, the first 22 miles are graded and the rail laid down. With the aid of the State, it is expected to complete this road and connect it with the Hudson and Berkshire railroad by the year 1842, the estimated cost is $1,200,000. This road will save some 30 miles between New York and Utica and strike the Hudson below the Overslaugh, at Catskill.

The *Hudson and Berkshire* railroad has been a year in successful operation, carrying, besides passengers and merchandize, large blocks of marble for the Girard College, Philadelphia, from W. Stockbridge to the city of Hudson, 33 miles, also a variety of manufactured articles from Berkshire county to the Hudson river.

This road intersects at the New York State Line the *Great Western railway* of Massachusetts. The distance from the city of New York via. Hudson to Boston is 302 miles, by the N. Y. and Albany railroad the distance will not exceed 290 miles. The *Ithaca and Owego* railroad is 29 miles long, it connects the Erie canal and Cayuga Lake with the Southern railroad at Owego. This road is completed and in succesful operation;

it has had the aid of the State to the amount of $300,000. A very important railroad has recently been constructed from the coal and iron mines of Blossburgh in Pennsylvania by Corning in this State, to the Chemung canal and Seneca Lake, thus forming the connection of our salt and plaster regions with the iron and coal districts of Pennsylvania. When this line is extended from the outlet of the Seneca Lake and Erie canal to Sodus Bay, by the Ship canal (in the course of construction) the city of Philadelphia will have a communication with the Upper Lakes and the Canadas, through the State of New York which her citizens have long desired to accomplish.

The *Albany and West Stockbridge* railroad although not commenced, yet from the unanimity with which the citizens of Albany have voted to issue the stock of the city, for 650,000 to construct this road, thereby to connect themselves with Boston, it will soon be in progress. The pledge given to Boston on the part of Albany to construct this road, on the completion of the *Western* railroad of Mass., places the construction of the Albany and West Stockbridge railroad beyond a question. It should prompt the immediate construction of the New York and Albony railroad to preserve a share of the New England business, that now centres mainly in New York with our auctioneers and jobbers. Boston, with the advantage of a continued line of railways from her long wharf, by Albany to Buffalo, *to Oswego* and Lake Ontario will command a large Western trade.*

Mr. Cunard is about establishing a line of steam packets from Boston to England, when the trade of Mass. and the other New England States, it will be perceived, will render the construction of a railway from New York to Albany and Troy, a measure of the first importance. If neglected, the *Western* railroad of Massachusetts will divert a large share of our Breadstuffs "to Boston," to be exchanged with the best customers for her manufactured cottons and woollens and the great variety of maufactured articles now sold principally, in the cities of New York and Philadelphia for the West. The limited period of 7 months the Erie canal is navigable, with the Hudson river closed from Dec. on the average to the 17th March, render the construction of railroads indispensable to New York, to afford her customers a quick conveyance for their goods *at all seasons of the year.*

J. E. B

The memorial of Gen. Gaines to Congress, has been for some time upon our table. Its merits, however, are such as are not likely to be lost by keeping. We shall give such portions as are calculated to interest our readers.

TO THE SENATE AND HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA, IN CONGRESS ASSEMBLED:—*the memorial of Edmund Pendleton Gaines, Major General in the Army of the United States, commanding the Western Division, respectfully showeth, that—*

Believing the Federal and State Constitutions guarantee and consecrate to every free citizen capable of bearing arms, the *right* and *duty* of participating alike in the civil and military trusts of the republic—solemly requiring the soldier to exert his every faculty "*in peace to prepare for war.*"

* Since the foregoing was written, eastern capital has agreed to cash the Albany city bonds, and construct this road. Messrs. Mc Neill and Whistler are preparing to put the whole line under immediate contract.

so that on the recurrence of war he may be well qualified to fight the battles of his country in the greatest possible triumph, and at the least possible cost of blood and treasure—requiring him, moreover, to study and respect her political and social institutions; and requiring the statesman to discipline his mind for the state and national defence, by adapting his civil acts and occasional military studies to the purposes of the national defence and protection, as well against foreign enemies in war, as against the home incendiary and other *criminal offenders in peace*; thus rendering the statesman & soldier equally familarized with their common kindred duties of *self-government* and *self-defence*: by a knowledge of which our Independence was achieved, and without which this inestimable blessing cannot be preserved—your memorialist, a native Virginian, a citizen of Tennessee, schooled in *her cabins* and *her camps* to the profession of arms, has, within the last seventeen years matured a System of National Defence, to which he now respectfully solicits your attention and support: a system of national defence whicq the late giant strides of invention and improvement in the arts, have rendered *indispensable to the preservation of uniov*: a system of national defence which recommends itself peculiarly to the Central, Southern and Atlantic States as well as to those of the North and West; as it assures to our insolated central States of Tennessee and Kentucky, and to all the Western States of Ohio, Indiana, Illinois, Missouri and Arkansas, in peace, commercial advantages equal to those enjoyed by the most favored Eastern Atlantic or Southern States—and *in war*, giving to the disposable fighting men of these Central and Western States the inestimable privilege of flying with unprecedented certainty, celerity and comfort, to any of our vulnerable sea ports, to aid our brethren of the border States to repel the invading foe: and to accomplish this essential duty in one tenth part of the *time*, and one tenth part of the *expense*, that would attend such an operation over our present bad roads.

But above all, to accomplish these great and good objects by means that will more than double the value of our State and National Domain; and without expending a dollar that may not be ensured to be replaced in the public coffers in from seven to ten years after the completion of the work here recommended.

Your memoralist is admonished by the universal employment of Steam Power, and its applicability to every description of armament hitherto moved upon the sea by wind and canvass, or upon the land by animal power, that an epoch is at hand, in which the art of war, in whatever regards the attack and defence of sea ports, has undergone an unparalleled revolution.

Hitherto the transition *from peace to war*, between neighboring nations, though sometimes sudden and unexpected, was usually preceded by some significant note of preparation not easily mistaken; and after the actual commencement of hostilities, there were frequent opportunities and ample time for the belligerents, and more particularly for the nation acting upon the unerring principle of *self-defence*, to complete the *work of prepration for war*, before the *work of destruction* upon her principal sea port towns had been begun by the invading foe. Hitherto the enemy's fleets were to be seen for weeks, often indeed for months in succession, "*standing off and on*," waiting for suitable winds and weather to enable them to enter and attack the destined port, and then in case of accident, to carry them safely out again: winds such as could never be calculated on with any thing like certainty. Hence the great and unavoidable delay in the attack by fleets propelled by wind and sails, has often enabled the people of the threatened sea ports to throw up works of defence—and after slowly marching their interior volunteers and other forces, at the rate of 20 miles a day, they

would in time be so well prepared for action, that the menacing invaders have but seldom ventured to attack places of much importance; but have usually condescended to vent their prowess in a petty border war against villages and private habitations: as upon the Chesapeake Bay and the Georgia sea coast in the war of 1812—13—14.

If the obvious effect of steam power in the rapid movement of every thing to which it has been applied around us, has not been sufficient to convince us of the expediency and transcendant advantages, *in war* and *in peace*, of the proposed immediate work of preparation by steam power, to guard against the incalculable disasters that must otherwise attend the sudden out-break of war with any of the great nations of Europe able to send against us even a small fleet propelled by steam power, it would seem obvious that the late naval and military operations in the hurbour of Vera Cruz were sufficient to prove clearly, that to bring a hostile fieet *inside the breakers* of a sea port of the country invaded, and within the desired range of the best of cannon and mortars for *red hot shot and shells*of one of the strongest castles in America, was the work of but two hours; and that the utter destruction of that castle by three small ships of war required but four hours more.

To provide for the defence of our sea ports—and thus effectually to obviate the possibility of a sudden calamity like that which has befallen the castle of San Juan de Ulloa, and to enable us to repel by the agency of steam power every invasion suddenly forced upon us by fleets propelled by steam power, I now submit for the consideration of the Notional Legislature the project and explanatory views which follow:

Art. I. *Floating Batteries*—for the defence of the sea ports and harbors of the United States:

Sec. 1. Your memorialist proposes the immediate construction of from two to four large Floating Batteries for the defence of each navigable pass into the Mississippi river; and from two to five others for the defence of every navigable inlet leading into any of the prircipal sea ports of the United States. Each floating battery to be from 200 to 300 feet long, and from 90 to 150 feet wide—the bottom to be as nearly flat as the best tested principles of naval architecture will allow, consistently with the great weight of timber and metal to be provided for, with the requisite facility of the movement that will be required over shoal water. Each floating battery to be secured in the bottom and sides with copper sheeting and copper or iron bolts; and on the upper parts, exposed to the enemy's shot and shells, with the thickest sheet iron, and iron bolts—and otherwise made capable of sustaining a heavier broadside than the largest of our ships of war is capable of sustaining; to carry from one hundred and twenty to two hundred heavy cannon—say long 24 and 32 pounders, with some 80 pounders for carrying hollow shot, together with some mortars for throwing shells; with a furnace for heating red hot shot for illuminating the enemy's fleets and transports. Each floating battery to have state rooms for the comfortable accommodation of from 600 to 1000 men, with store rooms for all the munitions of war requisite for that force for six to eight months service. Each floating battery to be attended and propelled by such number of tow boats as the exigencies of the service shall from time to time demand—to be permanently stationed in each harbor in time of peace: and in war as many tow boats to be chartered as the commanding officer may deem necessary to render the floating batteries in the highest degree efficient: as in war tow boats will seldom be needed for the merchant service, an ample supply of them, particularly in our large sea ports, may be chartered on moderate terms; for example, in the harbor of New Orleans it is believed that 12

tow boats, with several steamboats having the best of engines to be converted into tow boats, would be thrown out of employment during a state of war. These could be usefully employed in the United States service, in aid of the public tow boats and floating batteries. But should this reliance be deemed unsafe, we can readily adopt the obvious alternative, of having each floating battery supplied with two tow boats of great power, as in war they would be needed near the batteries, ready to wield them in the event of an attack, and at other times to act as tenders, in supplying them with men and munitions of war. In a state of peace the floating batteries, it is believed, would require but one tow boat each, excepting when employed in deepening the ship channels; a work which may be accomplished with the most perfect ease, and to any desirable extent, wherever the bottom of the channel consists of mud and sand, as in all the outlets of the Mississippi. This important work will be done by attaching to the bottom of each floating battery a frame work of *ploughs* and *scrapers of iron*, made to *let down* and *raise up* at pleasure, according to the hardness or softness of the clay and sand, or mud, of which the bar, or bottom of the channel may be composed. If very hard or tough, the ploughs and scrapers might not break up and take off more than two to four inches in depth at one movement; but where the bar is composed entirely of soft mud, as that at Balize and the N. E. and S. W. pass have often been, from four to six inches in depth it is believed may be carried off at once—wherever the bar is very narrow, and in the immediate vicinity of very deep water, which would be the reservoir, or place of deposite to which the mud and sand would be removed. But in a state of peace, when the batteries should not be employed in deepening the ship channels, their extra tow boats might be advantageously employed in the merchant service.

* * * * * * * *

5. But it has been contended by men of high pretensions in theory, if not in the practical science of war, that, in place of the floating batteries here proposed as means of *harbor defence*, we should direct our attention mainly to the construction of steam *ships-of-war*. In reply to this theoretical suggestion, it is only necessary to say that we must, indeed, ultimately have *steam ships-of-war*, or we must give up the whole of our foreign commerce; but if we desire to preserve our sea ports and commercial emporiums, we *must* have for their protection *floating batteries*—which constitute, in the present state of the arts, the natural link in the great chain of national defence, between the land and naval means of service: and as these floating batteries are not designed for going to sea (excepting near our ports and harbors in calm weather) they properly belong to the land service.—The fact that our sea ports are rendered more than ever liable to sudden and unlooked for attacks by fleets propelled by steam power, renders it all important to their security that our means of harbor defence should never, even for a single day, be left exposed to an assault, when that assault may, in all human probability, result in the destruction of one of our most vital points of military and commercial operations. If, however, steam ships of war should be preferred to the proposed floating batteries, a solemn act of congress should be passed, forbidding any officer from removing them beyond the immediate vicinity of the harbor to which they may be assigned; as it must be obvious that our sea ports cannot be protected without every requisite means of protection are held ready for action within our harbors, respectively. The floating betteries, it is believed, will cost but little more than the timber, iron, copper and other materials for their construction, if they are built as they should be, by the troops intended to defend them, aided by some ship carpenters to give them tight bottoms.

6. With three to five of the proposed floating batteries placed in the form of a crescent across the Mississippi river, with the concave side of the crescent down the river, and this curved line of floating batteries flanked by a small temporary fort on each bank of the river, so as to bring the cannon of each fort or battery to bear on any fleet or vessel *ascending the river from the sea*, we should be certain thus to give each of the enemy's leading vessels *a double cross-fire*, raking them in front and on each side at one and the same time; with several of our heavy guns from each one of our floating batteries and adjacent forts *with red hot shot*—a description of defence which would to a certainty, in 99 cases out of 100, be fatal to any fleet that could possibly be brought against our line of batteries. But to make assurance doubly sure, we could have our floating batteries occasionally connected together by *chain cables* and *chevaux de frize*, which might sometimes bring us in close contact with a daring foe, as Nelson or our own Decatur and Perry were, in the mode of attack which characterized those chivalric naval commanders. But the contact thus produced would ensure to us the moral and physical effect of our efforts being in *self-defence*, with the superior strength of our *batteries*, *bulwarks* and *weight of metal*—advantages which we should enjoy from the moment the invading foe comes within the range of our long and heavy cannon, until he finds himself entangled in, and arrested by our *chevnux de frize*—where the contact would be so close as to enable us to throw into his ships *hand grenades* and *incendiary shells*, with an occasional supply of heated steam; whilst our own batteries would be preserved from a similar annoyance by their superior width, strength and peculiar structure of their upper works, which are proposed to be secured by sheet iron of immense thickness; a description of work which it is believed could not be so effectually applied to vessels of any thing like the ordinary model of ships of war desined for sea service.

But again—"to make assurance doubly sure," we should not risk such places as New York and New Orleans—by far the most vital and in a civil and (the latter more especially) in a military point of view, the most important sea ports in America—without at least two curved lines of defence, one at or near the entrance of the harbor, and the other at the next narrow, strong, interior point, fortified as above suggested, with the curved line of floating batteries flanked by a fort on each side of the river or channel; for example—for the harbor of New York, *the Narrows*—and for the Mississippi, *forts Jackson* and St. Philips. * * * *

8. So much for their uses in a state of war—then on the return of peace when the most expensive fixed fortifications are absolutely useless, and moreover, a heavy burden to the country to keep them in repair, floating batteries will be usefully employed as barracks and hospitals; and in deepening the channels, liable to be filled up by clay, and loam, and sand, as those at the mouth of the Mississippi river are often filled up. As floating barracks and hospitals, the proposed batteries would be of essential benfit to the service every where, inasmuch as the outlets of our rivers and sea ports are generally healthy positions; and they will form the most appropriate asylums for our convalescent or slightly disabled soldiers or seamen; most of whom will render essential service in preparing fixed amunition, and in the instruction of the young and inexperienced, and in holding them ready for action; above all, in a state of peace the proposed floating batteries will be of immense utility to the service for all purposes of *military schools*, to which the aspiring youth of our country of the community will gladly repair, for the attainment of military knowledge, where it can be acquired both *in theory* and *in practice*, and where its *study* and *practice*

will be rendered most delightful and praiseworthy by the simple process of *the students rendering immediate and important public service in return for the public instruction received by them.* The military education of our youth should commence at the age of sixteen, and be completed at the age of twenty-one, or twenty-two. If our youth are educated upon floating batteries at the entrance of our harbors, near the Balize, Sandy Hook or the narrows; otherwise, if the youth of each Atlantic or southern State, are educated at the entrance of the principal seaport of such State, the graduate after finishing his education would have the proud satisfaction of exhibiting to his parents or guardian, on his return home, the gratifying evidence of his having performed five years honorable service, while acquiring attainments qualifying him for a high—*perhaps the highest—command in the army:* attainments, too, tending to qualify him in no small degree for the highest stations recognized by the free institutions of our country; and exonerating him forever after from any other than mere voluntary service. * * * * * * *

Art. II. So much for *Floating Batteries* and their uses in peace and in war. Let us now proceed to consider the all important kindred measure of Railroads, for co-operating with the proposed floating batteries, and perfecting the promised system of national defence.

Sec. 10. We propose the immediate location and construction of seven railroads, to extend from the two central States of Tennessee and Kentucky to the seven grand divisions of the national frontier, as suggested by a plan embraced in the accompanying diagram, viz:

First—One principal railroad from Lexington, Ky., to Buffalo or Plattsburg, N. Y., with branches to Detroit, Albany and Boston.

Second—One principal railroad from Knoxville, Ten., to Norfolk, Va., or Baltimore, Md., with branches to Richmond, Va., and Newbern, N. C.

Third—One principal railroad from Memphis Ten., to Charleston, S. C. or Savannah, Ga., with branches to Milledgeville, Ga., and East Fla.

Fourth—One principal railroad from Louisville, Ky., to Mobile, Ala., with a branch to Pensacola, Fla.

Fifth—One principal railroad from Lexington, Ky., via Nashville, to New Orleans.

Sixth—One principal railroad from Memphis, Ten., to the Sabine ridge with branches to Fort Towson and Fort Gibson, Ark.

Seventh—One principal railroad from Louisville, Ky., or Albany, Ind., to St. Louis, Mo., and thence to the Missouri river north of the mouth of the Big Platte, with branches from Albany, Ind., to Chicago; and from the north west angle of the State of Missouri to the upper crossing of the river Des Moines.

11. These seven great arteries or principal railroads here enumerated will each be from 500 to 700 miles in length (averaging 600 miles) making altogether a distance of 4,200 miles, and the average cost of locating and constructing them is estimated at $15,000 per mile, amounting altogether to the sum of $64,000,000—provided they are located and constructed by the army of the United States: the railroads to be of the most substantial kind, each having a double track. The whole work to be completed by the authority and at the expense of the United States: provided that on its final completion it shall revert to the States in their sovereign and individual capacity—each State to retain, forever, the right of property in and to all of such section or sections of the said railroads, with all their appurtenances, lying or being within the territorial limits of such States, respectively—upon the single condition that all troops, whether regulars or volunteers, in the service of the United States, with their mu-

nitions of war, together with the mail, shall be transported forever upon these railroads, free of expense to the United States.

12. Without attempting to enumerate all the benefits to be derived from the proposed railroads, in peace, as well as in war—benefits which are for the most part too generally known to require any particular notice here; —(and others, certainly of very great value, can only be conjectured, inasmuch as they are to some extent *invisible*, and to be developed principally, it is believed, by the excavations necessary to complete the graduations of the basis of the work through the vast regions of *mineral wealth* over which its various lines will extend, where accident has hitherto led to the discovery of a sprinkling of gold, with millions of acres of the richest iron and lead ore and coal, together with copper and other valuable minerals;)—your memorialist will here concisely advert to the principal benefits which the military aspect of the proposed work promise, and conclude with a notice of such advantages as must immediately result to the *army to the several States* and the UNION, from the organization and employment of the national regulars and volunteers as operatives upon the work.

13. *The principal advantages to be derived from the proposed railroads in a military point of view.*

In a state of war they will enable us to transport the military men and munitions of war of the two central States of the Union, and of all the interior districts of the twenty-four border States, to the seven grand divisions of the national frontier, without animal power, in one tenth part of the time and at one tenth part of the expense that the movement would cost in the present state of our bad roads. The proposed railroads would thus enable us to obtain more useful service in war from ten thousand men, by the increased rapidity and safety of their movement to the point of attack chosen by the invading foe, than without railroads we could obtain from an army of one hundred thousand men, marched upon our common roads; as, in addition to the saving of *time*, which in war is *power*, and *health*, and *life*, and *money* we shall save our citizen soldiers from what they usually deem the most irksome and insupportable afflictions and privations attending their tours of military service: we shall save them from long and tedious marches, and from the still more trying scenes of a long continued delay in camp, and the consequent painful *separation from wife, children, friends* and *business*. On the contrary, after being assembled and prepared for action, we shall *fly* to meet the invading foe at the rate of 250 to 300 miles in 24 hours—taking with us every desirable necessary of life for the preservation of health, activity and personal prowess; so that when we meet the enemy, we shall enjoy every desirable advantage in every conflict, in most of which we cannot but be successful; and in place of the usual campaign of three, six or twelve months of distressing service, we may reasonably calculate on being conveyed, with every desirable supply from the central States to the frontier, in the short space of 50 or 60 hours time, and of meeting and beating the invading foe, and returning to our homes in a few days, or at most a few weeks more. Hence the great utility of the proposed railroads in a state of war; and then, on the return of peace, when our 60 millions of dollars worth of fortifications, and armories, and arsenals, and ships of war are worse than useless, for any of the purposes of peace, and a great and constant expense to repair and replenish them in order to hold them ready for another war; then, our railroads, taking, as they must take, precisely the direction that the commerce of our country takes—from the seaboard to the central western States, will, when turned to commercial purposes, produce a revenue to the States that own them, that will be more than sufficient to replace, in seven years time,

every dollar expended in their construction; and forever thereafter produce a revenue sufficient for the support of all the State governments, and to pay for the education of every orphan child in America. The proposed railroads will do more—they will form ligaments of union more powerful than bulwarks of adamant, or chains of iron or gold, to bind the States together in perpetual union. In designating the military men of the central States of Tennessee and Kentucky, as the disposable force of the nation, we have reference to the fact that this force is rendered disposable by the central position of these two States—they having no frontier to defend; whilst the forces of all the other twenty-four States are rendered local forces, and not disposable, by reason of their being all border States—the boundary of each extending to the frontier; and therefore, having frontier of their own to defend, they are thus rendered local, not disposable.

14. Organization of the regular forces and operatives to be entrusted with the location and construction of the work.

One Major General; one Adjutant General, with seven assistants; two Brigadier Generals; seven Surgeons, with 28 assistant Surgeons; and 28 chief artificers, or scientific mechanics; seven regiments; each regiment to consist of one Colonel, two lieutenant Colonels, four Majors, one Adjutant and one Quartermaster, two sergeant Majors and two quartermaster Sergeants, with ten companies—each company to consist of one Captain, two first Lieutenants, two second Lieutenants and two Cadets, with one quartermaster Sergeant, one orderly Sergeant, four Sergeants, four Corporals, two musicians, ten artificers, and 80 private soldiers. The General, Field and Staff officers, with the Captains and first Lieutenants, to be taken from the officers of the Engineers, topographical Engineers, Artilery and Infantry now in service—officers of established reputation for professional talents, experience, industry, economy and exemplary habits; and to have the pay and emoluments of mounted dragoons, with 50 per cent. additional pay while actually employed as Engineers, superintendants or operatives upon the location or construction of the work.

15. *Location of the proposed railroads.*

The location must embrace the *nearest and best routes*—commencing within the two central States of Tennessee and Kentucky, and extending to the seven grand divisions of the sea board and northern frontier, as above suggested; to be ascertained, particularly through the mountainous regions, by a series of topographical surveys, and finally decided on and established by a board to consist of a General and four to six field officers, upon whose decision the Major General commanding upon this service should have power to act; to approve or disapprove the decision of the board upon the same principles that the President is authorised by the constitution of the United States to approve or disapprove an act of Congress.

These surveys will produce an immense mass of ***Mineral, Geological*** and *topographical information* of great value to the States and the Union, and of indispensable utility to every member of the army and militia of the nation who aspires to that employment in the national defence which leads to the true fame of a citizen soldier: information tending to develope the military and physical resources of every State and district preparatory to a state of war, and of essential benefit to the people of every class during a state of peace.

(To be continued.)

THE PRESIDENT SPEAM SHIP.

This vessel, the largest ever yet built, arrived here a few days ago under

the command of Capt. Kean, and is now lying in Sloyne. She is an exceedingly beautiful model; built of the best material that England and England's wealth can supply, and is in every respect a noble vessel. She is now (her engines not being yet on board,) what is in nautical term, called "light;" and loomes very large. Her proportions are, however, such but for the comparative size of the Queen's mail ships near her, she is so compact that she does not appear at even a short distance to be larger than the "Liverpool." A nearer approach, however, undeceives the beholder, and a visit on board, realizes to its fullest extent the conception of "a wooden world."

She is painted in man-of-war style, with gun ports, and is handsomely rigged as a three-masted schooner, with a foremast, fore-top-mast, and top-gallant-mast, approximating to those of a ship. Her bow is fine, and at the extremity of her head rails will be placed when completed, as a figure head, a bust of Washington, the hero of American independence. Her stern is projective, beautifully formed to turn off a heavy sea; ornamented aloft with the arms of England and America, quartered in heraldic shield, supported by "the Lion of England," and "Eagle of America." The paddle boxes are comparatively very slightly raised above her bulwarks; and her general appearance is, when her side is viewed, that of a first class frigate of extraordinary size, her light rigging giving her at the same time a most rakish and mischievous appearance.

The following are the dimensions:—

Length over all, from taffrail to figure head, -	273 ft.
Beam within the paddle boxes, - - -	41 ft.
Breadth from outside of paddle boxes, - -	72 ft. 4 in.
Depth of hold, - - - - - - -	30 ft.
Height between the main and spar deck, - -	8 ft. 6 in.
Height between lower and main deck (both flush)	7 ft. 8 in.
Tonnage supposed 2500.	

Those who are versed in maritime affairs will readily conceive from these dimensions that we are warranted in stating that the President, is in reality, "a wooden world." She is indeed, more—she is a world not only of wood, but of iron, copper, and other materials, constituting the *ne plus ultra* of strength in naval architecture.

The President was built at Limehouse, London, by Messrs. Curling and Carter, the latter gentleman superintending her construction throughout.

Between decks and in her holds she presents a perfect picture of strength; and we cannot more highly compliment our metropolitan firiends and contemporaries in Translantic Steam Navigation, then by stating that they seem in materials, in fastenings, and in putting together, to have taken a leaf out of the book of our townsmen Messrs. Wilson and Co., whose vessels both in point of strength and sailing have hitherto borne the belle.

Every available modern improvement has been taken advantage of in the construction of the President. In addition to a remarkably strong frame, solid to the bilge, she is diagonally fastened fore and aft with iron and wood, in a manner that would seem to defy the rudest assaults of the ocean wave. We have not time to enter into details. Suffice it to say, that the materials of the *President* throughout are of the best quality, and that the utmost science, in a scientific age, has been exerted to work them to the best advantage.

The engines for this vessel will be of about 600 horse power. They are already built by our townsmen Messrs. Fawcett and Co., and present a splendid specimen of the ingenuity and enterprise of the age.

The *President* will present peculiar advantages for passengers. Her

spar-deck will afford a long and delightful promenade in fine weather, and during rain or storms a dry and sheltered walk may be enjoyed below.

The cabins are not yet fitted up. The principal or stern saloon will be eighty-seven feet in length; its breadth (including the small state rooms on each side) forty-one feet.

No expense has been spared to render the *President* a crack ship. In strength of materials and fidelity of workmanship, she is fully equal to any of her Majesty's ships of war; and is fitted up with all the modern improvements in pumps, tanks, &c. She is also divided into sections, so that the springing of a leak (should such take place) would be attended with comparatively trifling danger. It is calculated that the *President* will carry 1,000 tons of goods beyond her compliment of coals, luggage, and materials for a transatlanitc voyage. Her steering tackle is of novel and improved construction; and such was required; for, from her length and size, she may be deemed a floating island.

The agents of the *President* at this port, are Mr. Pim, of the St. George's Steam packet Company, and Mr. Macgregor Laird, brother of Mr. Laird, of North Birkenhead, the celebrated builder of Iron ships.

New York and Albany Railroad.—In a former number, the importance of the New York and Albany railroad was presented, in connection with the efforts of Boston to divert part of the trade of the West to that city during two thirds of the year, and the whole of it during the remaining one third, after the closing of the Erie canal and Hudson river. Its cost, on an actual proposal of $2,450,000 with security, was presented, as well as the superiority of this route over all others.

It now remains to be asked, can the New York and Albany railroad pay an interest to its stockholders on its cost, with the noble Hudson river only 15 to 25 miles distant, on which steamers are runniug at from $1 to $2 per passenger, exclusive of meals? I answer in the affirmative; and I will endeavor to substantiate the same by a few but important facts.

The disposition of the American people "to go ahead," with their desire for variety, is such, that the route that carries the mail and saves 4 or 5 hours in time, will take its share of passengers. The railway will certainly carry all the way travel, which now passes by the Hudson river to New York, from Berkshire, Massachusetts, Litchfield Connecticut, and the East parts of Columbia, Dutches and Putnam Counties. It is calculated that from 1000 to 1500 persons pass to and from different points on the Hudson river by steamboats daily. The average of persons coming from and going to the West over the Utica and Schenectady railroad, may be stated at 200,000 persons annually. Of this number it may be estimated that 50,000, including the winter travel, would take the New York and Albany railroad.

This item, at $2 50 each, equals (See Assem. Doc. of 1839, No. 171, for details of estimates)	$125,000
The *way travel*, has been estimated by Mr. W. C. Redfield and other intelligent gentlemen, at above	$100,000
This road will transport over it at least two trains of 100 tons each daily, from the towns on the line, at say the average rate of $3 per ton. This item will give 73,000 tons, or (See Assem. Doc. No. 171, 1839)	$219,000
If the road is well regulated, with suitable *turnouts*, ten times this amount may be conveyed over it daily, at even half this expense. The U. S. mail at the present rate allowed by law ($300 per mile) will yield	$44,000
	$488,000

That the traffic will be immense on the line of this road, towards its termination, is shown from the fact, that it is destined to become the great thoroughfare to supply this increasing city *with provisions and building materials.* This too, without taking into view that all the *early* Spring trade in merchandize from the city of New York to the West, *must* seek the railway, at any price of transportation, to keep pace with this *new mode of transportation.* It will be safe to give the road $200,000 in addition to the estimate, for the trade and traffic from the towns on the line of the road to Albany and Troy. The gross income will exceed $688,000 per annum, and must increase yearly with our population and wants.

There are advantages to the residents in this city, and its vicinity, in the reduction of prices for the necessaries of life, that it is difficult to calculate by dollars and cents. The importance of the road, in this point of view, to the property holder, the merchant, the mechanic, and the laborer, is great. To the latter, in the necessary article of milk, the calculation is a striking one. There are at least 50,000 families (6 persons to a family) in this city and in brooklyn, who consume 3 pints per day, at an average in price for the *pure* article, of 7 cents per quart, winter and summer. This calculation does not include the steamboats, packets and extra quautities for hotels.—75,000 quarts for 365 days is 27,375,000 quarts per annum, at 7 cents $1,916,250

It has been ascertained, that milk reduced to butter, does not nett the farmer in Dutchess, to exceed one and a half cents per quart, supposing the butter sold at 25 cents per lb.—Say, then, 4 cents per quart of milk, to include profit on delivery in this city, equals 1,098,000

May be saved yearly in the item of milk $818,250

In the item of the reduced price of *Vegetables*, for the daily tables of 50,000 families, it is safe to say one shilling each will be saved per day.

This in 365 days at $45 per family, will amount to the enormous sum of $2,225,000,—or $6,250 daily.

On the closing of our canals, for five months in the year, the daily consumption in this city of flour is 1,500 barrels. During the summer it varies from 1000 to 1200 barrels per day. 150 days at 1500 bbls. equals 225,000 bbls. It is well known to our bakers, that on the closing of the Erie canal, we are in the power of speculators, who advance the market from one to three dollars per bbl. The difference in value to the consumers (from not having a line of railways to the wheat districts) may be safely put down to the consumers, in this city and its vicinity, at $500,000;—and on the quantity required for the consumption of the New England States, at one million of dollars.

The *mineral* resources along the line of the road, particularly *in Iron*, are immense. The State Geological Reports of 1839, give the items in detail.

Marble and *Granite* abound—so do ship timber, wood, and charcoal, with every agricultural product required for a growing city. On a rough estimate, there are at least 30,000 horses and cows on and near this island, with cattle sent here for sale, which consume on an average two tons of hay per annum each :—say 50,000 tons of hay. The railroad will save to the farmer and consumer at least $7 per ton, and this will equal $350,000.

Other and more enlarged views, may be taken of this work. *In a military point of view*, its construction and connection with the U. States Arsenal at Watervliet, is important—it will unite the Sea Board with our inland seas and the far West—and be a means of defence to this city.

Without a railway to Albany, and through the State, we never can succeed with manufactures, particularly cotton. The new crop comes to market principally after the canals and the North river are closed. The period is not far distant, when the State of New York will be *the centre* of the *manufacturing district* of the United States. The *Grain district* must pass to the States of Ohio, Michigan, Indiana and Illinois, as our narrow belt of wheat land becomes yearly exhausted, or more valuable to produce stock, butter and cheese.

The *Cohoes Falls* may be made the Manchester of America. With a railway to Troy and to this important water power, for the supply of cotton and the return of the manufactured goods, the value of this property would be more than doubled. The same may be said of the property and water power, at the Little Falls. At the Cohoes, upwards of $800,000 of New York and Eastern capital has been invested, and a very large sum at the Little Falls. These several Companies could give, with profit to themselves, one third of their investments, to secure an uninterrupted communication to the Mills. It is to be hoped the period has arrived, when the Chamber of Commerce, the Board of Trade, with our land holders and citizens generally, will make a united effort, to complete a railroad within our own State and jurisdiction *direct* to Albany.

Let the "*Right of Way*," or ground over which to construct the road, be got forthwith. By proper management, it will cost the Company but a trifle. Let a subscription to the stock of the Company be started, in every election district, in every ward in this city. If placed in proper hands, there cannot be a doubt but that $1,500,000 to $2,000,000 can be obtained in small sums, from those interested in the immediate construction of this road. Let it by all means be completed simultaneously with the Albany and West Stockbridge road. This event may then be celebrated with as much pomp and final advantage to this city, as "the mingling the waters of the Upper Lakes with those of the Atlantic." The one gave us a communication with the West, seven months in the year;—the railway, will give us communication with the interior the whole year; and in the view of many, the advantages to this city of one improvement compared with the other may be estimated in favor of the railway over the canal, as 12 to 7; certainly when we take into consideration the trade we are on the eve of losing, from the steady enterprize of our Eastern neighbors.

Jos. E. Bloomfield.

INSTITUTION OF CIVIL ENGINEERS.

Feb. 21,—The President in the chair.—The following communications were read:—

"On Steam Engines, principally with reference to their consumption of Steam and Fuel." By Josiah Parkes, M. Inst. C. E.

The above is the second and concluding communication on this subject; in the former, the generation of steam more particularly was considered; in the present, its application when generated. These are distinct questions, as it is the economy of steam which constitutes the dynamic perfection of a steam engine, whereas it is the economy of heat in supplying that steam which constitutes the perfection of the boiler as an evaporative vessel. These economic properties are totally independent of each other; they may co-exist in a maximum degree, or in very different degrees, and the degree of perfection which any particular class of engines, or which the particular engines of any class possess, is known from the weight of fuel burnt, of water evaporated, and the mechanical effect realized. As

long as engines were constructed with but few varieties, or identical in their forms, the performance of one was a sufficient indication of the performance of all; but new forms of engines and new modes of practice being now introduced, a comparison of the performance on the several systems is a matter of deep practical and scientific interest. With the view of effecting this object, the author has collected all the authentic facts within his reach, and reduced them to common standards of comparison.

The effective power of steam engines may be ascertained either from the resistance overcome, or from the load upon the piston by means of the indicator; the former method being applicable to pumping, the latter to rotative engines. But the effective power of the steam in pumping engines, as thus ascertained, is far below the real effective power of the steam, and no exact comparison can be made by these means between the effective power of the steam in the two classes of engines. The useful effect is not synonymous with a true measure of effective power, since the duty is the true useful effect in a Cornish engine. The indicator when applied to the Cornish engines enables us to ascertain the absolute but not the effective power, so as to compare it with that of the rotative engine, since the friction of the engine and the load cannot be separately determined. The absolute power of the steam may also be ascertained from the relative knowledge of the elastic force of steam corresponding with the ratio which the volumes of water bear to each other. This theoretical estimate requires, however, several corrections; among which the steam condensed by contact with colder surfaces, the steam consumed in filling useless places, and that lost by priming, must be particularly noted.

The relative performance of pumping engines is well expressed by the term "duty," that is, the number of lbs. raised one foot by a given quantity of fuel; and of rotative engines by the term "horse power;" that is, the number of lbs. raised one foot in a minute, divided by 33,000 lbs. the standard measure of a horse. The performance of the rotative engine may also be estimated by duty, and of pumping engines by horse power. The results of these computations for several engines are tabulated in this communication.

The sum of the latent and sensible heat being constant for steam of all elasticities, the expenditure of both power and heat is truly measured by the weight of water consumed as steam; this measure is free from all uncertainty, and independent of all theory; the weight of water as steam is equivalent to the production of a horse power in each engine, and the duty effected by one pound of steam, will denote the positive and relative efficiency of the steam and the heat. These indices of efficiency being referred to some standard, we learn, from the preceding data, the precise value of each engine in its use of steam and fuel: of its boiling apparatus, as a generator of steam; of the comparative efficiency of the steam and coal, or economy of power and fuel. The results which may thus be obtained are also exhibited in tables accompanying the communication.

The power resulting from the expenditure of equal weights of water, as steam, being known, the boiler may be connected with the engines, and the relative extent of heating surface employed to furnish their power shown. It will thus appear that equal measures of surface are quite inadequate to supply equal power, with equal economy, to different classes of engines. These results are tabulated in great detail, and it appears that the Cornish engineers now employ nearly eight times as much boiler surface for equal nominal power as that given by Watt's practice. But taking into account the fuel burnt per horse power per hour in the two cases—the Cornish engine consuming 2½ lbs. per horse power per hour, and Watt's engine

$8\frac{1}{4}$—the true relation of the boilers is as 19 to 1. Many other relations of a similar striking character may be deduced from these tables.

The detailed results of the experiments by Smeaton in 1772, on his improved Newcomen engine at Long Benton—by Watt, in 1786, on his rotative condensing engine, at the Albion Mills, are recorded in these tables; and it appears that the economy of the latter, as regards steam and fuel, was double that of the former, and approached very nearly to perfection in the use of power obtainable on that principle. The next great advance in the economy of fuel and power is that made by the Cornish engineers, whose performance, both with pumping and rotative expansive engines, far exceed any attained with the common unexpansive condensing engines. The superiority of two of these engines in 1835, doing a duty of 80 millions, exceeds the engines of Watt and Newcomen by $2\frac{1}{2}$ and 5 times in economy of power, and by $3\frac{1}{2}$ and 7 times in economy of fuel.

The obtaining a standard measure of duty is of great importance; a heaped measure, as a bushel of coals, is highly objectionable, as the weight of such measure will vary from 84 to 112 lbs. In the Cornish reports, the bushel is fixed at 94 lbs. weight, as the standard of comparison, but some portion of a ton or one lb. would be a better standard. Other combustibles, however, as coke, peat, &c., may be used partially, or to the exclusion of coal, and under these circumstances, some other standard of comparison is necessary, and with this view the author suggests a pound of water in the form of steam as the best standard of duty. The work done by a given quantity of water as steam is a sure index of the quality of the steam engine; it is a measure unaffected by variable calorific agents, and so long as engines continue to be worked by steam, so long will the performance of different engines be accurately gauged by their respective expenditure of water as steam. The accuracy of this measure depends on the physical fact of the constancy of the latent and sensible heat in steam of all temperatures. The author has recorded twenty-eight experiments made on twenty-eight different days, on vaporization from the boiling point to 60 lbs. pressure above the atmosphere, which present a remarkable confirmation of the above law, and show that the relative efficiency of steam in engines is due to the manner of using it, and not to any change in its chemical constitution at different pressures. The manner of conducting these experiments, and the precautions taken to insure accurate results, are detailed with great minuteness.

The author next proceeds to treat of the locomotive engine, and to discuss, compare and tabulate the facts relating to this engine in the same manner as he has done those of the stationary class. The qualities of the boiler of the locomotive as an evaporative vessel had been discussed in the first communication. The locomotive differs from the fixed non-condensing engine only in the use of the blast, and the same method of measuring the effects of the steam are applicable to both. Experimenters on the locomotive have generally attempted to determine the amount of resistance opposed to its progress, in preference to ascertaining the power expended in overcoming the resistance. The exact solution of either of these questions would furnish all that is wanted; but the ascertaining the total resistance by an analysis of its several constituents is attended with great difficulties, as the forces to which they are to be referred are so exceedingly numerous and variable, that the assigning the exact value to each at any one velocity has hitherto eluded the talents of those who have pursued this method. M. de Pambour was the first analyst whose labours will require attention. The results given by this author in his practical treatise on locomotive engines on railways were compared by Mr. Parkes with the

results which he had obtained when experimenting on an engine of precisely a similar character, and discrepancies presented themselves which appeared totally irreconcilable. These and other circumstances led the author to consider, whether the resistance to traction would properly be deduced from the laws of gravitation, or whether any certain results would be derived as to the amount of resistance on a level from observations on engines and tains moving down inclined planes. The great object seemed to be to discover some criterion of the mechanical effect produced by a locomotive at all velocities, which would apply as practically and as distinctly to a locomotive as duty to a pumping engine, or horse power to a rotatory engine. If this were possible, it seems of far less importance to distinguish the precise value of each particular unit of resistance, than to determine the relative sum of resistant and the relative expenditure of power at all velocities and under all circumstances. Now the term duty may be applied in the strictest sense of the term to the work done by a locomotive engine; for whether the engine drag a load whose resistance is 8 lbs. per ton, or whether a weight of 8 lbs. for each ton of matter moved descending over a pulley and attached to the load, be considered as the moving force, the result is the same. If, then, the tractive force, or resistance per ton of matter in motion, which is the real load on the engine, be ascertained, the whole effect is found by multiplying this sum by the space passed over in feet; and the consumption of water as steam and of coke being known, we have all the elements requisite for determining the duty performed by the steam or coke. The pressure against the pistons may be deduced from the sum of the resistances first calculated on the assumed resistance overcome at the velocity of the engine in each experiment; and the pressure on the pistons may also be deduced from the ratio of the volumes of the steam and water consumed. The results which may be obtained on these principles are tabulated, for the experiments of M. de Pambour, Robert Stephenson, and Dr. Lardner. In another table the author has recorded the reduction of each of these experiments to terms of horses' power, and has exhibited under that denomination the absolute power resulting from the steam used—that required to overcome the assigned resistance—their differences—and the power which balances the gross and useful duty. The construction of these most elaborate tables is described in great detail, and the consequences which follow from the tests thus obtained are fully stated, and the author comes to the conclusion, that results inconsistent with the capabilities of the locomotive are perceptible in almost every one of the experiments. A condensing engine placed on wheels, with water of condensation transported for its supply, and made to drag a train along a railway, would require the same expenditure of water as steam to produce a given effect, as if fixed; a non-condensing engine also is one and the same machine, whether fixed or locomotive, excepting that the latter must consume more power than the former, to do equal work, at like pressures, by the amount of the additional resistance arising from the contraction of its eduction pipes, in order to produce a fierce blast of steam through the chimney. From these and other causes the fixed non-condensing engine must be the more economical of the two; but if the results derived from M. de Pambour's data be correct, we must acknowledge the fixed non-condensing engine, with its simple atmospheric resistance, to be far inferior in economy of steam to the locomotive, with its plus atmospheric resistance. The experiments by Dr. Lardner were made for the purpose of determining the resistance opposed to progressive motion on railways. They consisted in dismissing trains at various speeds from the summit of inclined planes, and in observing their velocity when it became uniform, the resistance at such velocity being

equal to the accelerating force of gravity down the inclined plane. The results of these are tabulated in the same manner as the preceding, and the most singular discrepancies present themselves. For instance, it would appear that in one particular case a duty of double the amount of that effected by the condensing engine was performed by an equal expenditure of power; that compared with a fixed non-condensing engine at equal pressure, the locomotive, though laboring against the heavy counter-pressure of the blast from which the other is free, is assumed to have performed equal work with less than one half the expenditure of power. That if the resistance assigned by Dr. Lardner as opposed to the progressive motion of the train be correct, the efficiency of the steam in the locomotive is more than double that obtained by the best condensing engines; more than treble that derived from stationary non-condensing engines, and equal to the performance of a Cornish expansive engine, doing a 50 million duty with a bushel of coals. With such results before us, the resistances assigned as opposed to and overcome by the locomotive at different velocities, must be regarded as utterly inconsistent with reality, and as resting on no solid foundation.

(To be continued.)

Institution of Civil Engineers.—At a weekly meeting of this influential body, on Tuesday the 25th of February, three models were brought forward, which are worthy of a few words of notice The first of these was that of a canal boat, of small breadth of beam, and draught of water, about 80 feet long, and fitted for traction at the rate of 10 or 12 miles in the hour; the same as the port boats on the Ardrossan canal, in Scotland. The peculiarity of this model consists in the adaptation of an 80 feet boat to 60 feet locks, which is accomplished by having 10 feet at each end of the boat articulated by hinges, so that they may be turned into a vertical position when about to enter the lock. It seems that the weight of the men who conduct the boat is sufficient to make those movable ends act as part of one entire structure, when the boat is in progress through the water; and the additional pressure on the permanently horizontal 60 feet by the turning of them up, is an advantage rather than otherwise, when the boat is in the locks. This plan has been tried upon the Irish canals, and has succeeded.

The second model is, in our opinion, a very choice and valuable one. It is a sliding jack, by means of which the conductor and stoker of a railway engine can replace it on the rails without further assistance, in the event of its slipping off. It was very justly observed by Mr. Walker, the highly talented president of the Institution, "no railway train ought to be without this machine, which is of small weight and ready use, and can be carried in the tender with no trouble, and very little want of power."

The third model was that of a new mode of attaching the axis of the paddle wheels of a steamboat to the horizontal shaft of the engine, and detaching the same when necessary. We had not time fully to examine it, but from what we saw, we are inclined to think that it bears more analogy to the fable of the progeny mountain in labor.

Windsor Castle.—An accident, though as hitherto not a very serious one, which has occurred in this splendid national structure, shows how dangerous it is to tamper within the vicinity of the foundations of a ponderous building. This was a fracture of the wall at the north western extremity, close to Winchester tower, constructed by, and once we believe the residence of, the illustrious William Wykeham, and now the abode of Sir Jeffrey Wyatville. This fracture has extended to a length of twenty-five yards, and, as far as it has been explored, it extends down to the very found-

ations, and continues widening. The latter circumstance shows that the mischief done must be in the foundation not in the building, and that it may be much greater than it is at present. It seems that the cause of this, at least in so far as known, is the digging of a deep trench close to the new terace wall, by order of the dean and canons of Windsor, who are proprietors of the ground here. The intention was to carry off the water which ran from the terrace, upon the slope; but, from some cause or other, it did not answer this purpose. The ditch became a stagnant sink, the water of which soaked in towords the foundations, at the same time that the continuity of the abutment formed by the slope was broken; and, consequently, the wall of the new terrace, which is comparatively a green wall, was left without the requisite support. Thus, the operation was much the same as if one were to take out the backing of an abutment of a bridge, and fill its place with stagnant water, and the consequence has been similar. This is a remarkable instance, not only of the danger of allowing unskilful persons to tamper with what they do not understand; but, also, of that of allowing any party but the public to hold property, and carry on operations upon it, near to a building of such national honor and importance—to say nothing of expense—as this most splendid of British palaces.

Great Western Railway.—The ten-feet wheels attached to the locomotive engines employed on this railway not being found fully to answer the expectations of the directors, they have altered their plan, and in future wheels of seven feet diameter are to be employed. The result has been the attainment of the speed of fifty-six miles an hour. On Saturday, the 28th ult., the "Firefly," a new engine manufactured on this principle by Messrs. Jones & Co., of the Viaduct Foundry at Newton, made an experimental trip from Paddington to Reading, and the following is a statement of her performance. She left the station at Paddington at 13 minutes 18 seconds past 11 a.m., and reached Reading at 59 minutes 43 seconds past 11, having passed the first mile post at 11 hours 15 minutes 57 seconds, and the 35th at 11 hours 58 minutes and 44 seconds, which is equivalent to one mile in one minute and $17\frac{3}{4}$ seconds, or more than 46 miles an hour. During the journey one of the tender springs broke and caused some additional friction on the axles. The load was two carriages and one truck. At 3 hours 19 minutes and 2 seconds the party started on their return to London with two carriages. They stopped to take in water at Twyford, which detained them 14 minutes and 44 seconds, and finally arrived at Paddington at 21 minutes 3 seconds past 4. The 29th mile post from London was passed at 3 hours 44 minutes 50 seconds, and the second at 4 hours 16 minutes 21 seconds, which is equal to the speed of one mile in 1 minute $11\frac{3}{8}$seconds, or an average of $50\frac{1}{2}$ miles per hour. The greatest speed attained was from the 26th to the 24th mile post, which was done at the rate of 56 miles an hour. This is the greatest speed at present attained in the history of locomotive power; what will ultimately be the greatest it is impossible to foretel.

Liverpool and Manchester railway.—On Thursday night, the 14th inst., the heaviest load of merchandize that perhaps has ever been collected into a single train was transported from Liverpool to Manchester by two engines, the Elephant and the Hercules. The train consisted of 106 wagons, laden with cotton, sugar, and various other articles of produce, occupying an entire length of about one quarter of a mile. A tolerable accurate computation of the extent may be made by observing that the length of each wagon is three yards, the space between about one, and the engines, with their tenders, 22 yards; the distance from the foremost engine to the

last engine would thus be 442 yards. The weight of this mass of matter would, no doubt, exceed 600 tons; the average weight of the wagons, merchandize included, being nearly 5 7-8 tons, the two engines 28 tons. On arriving at the foot of the Whiston plane, the engines were of course stopped, to permit the division of the train into the requisite number of manageable portions, and the whole load, in three or four successive trips, was soon transmitted to the summit. Proceeding to the Sutton incline, a detention occurred in the descent, in consequence of the breaking of a chain which coupled two of the wagons; but after this interruption no accident took place, and the train arrived in safety at the end of its journey. We understand that the Liverpool and Manchester company have lately introduced an alteration in the system of working their merchandize, the bulk of which is transported at night, to ensure delivery at an early hour in the morning.

Improved method of making bricks.—"A simple method of making bricks is made use of on the Great Western railway on Mr. James Bedborough's contract at or near Marston. This mode, which is the invention of W. B. Prichard, Esq., Civil Engineer of this railway, and late of the Chester and Crewe railway, is as follows:—The clay, only wattered, is thrown into a common pugg mill (or mortar mill;) there it is ground in a similar manner to mortar; the bottom of the mill is divided into four quarters, into which are grooves cut, and under which are placed four moulds of the same kind as those in common use by hand moulders. Two boys are at the quarters taking the moulds out and placing others in; and by a peculiar knife in the bottom of the mill, which presses the clay into the mould, eight bricks are made every time the horse goes round, which is twice a minute; and at that rate the horse can travel twenty miles in twelve hours, thus making 960 an hour, or 11,520 per day. The bricks made by this machine are much heavier and sounder, and the clay much better tempered, than by any other mode of manufacturing that I have ever witnessed; and the saving of 2*s.* 6*d.* per thousand, besides other advantages, etc. Mr. Prichard informs me that he intends to present a model in a few days to one of the London Galleries. The whole cost of the machinery is about 10*l.*"—*Railway Times.*

The Oscillating Steam Engine.—This description of steam engine was invented many years since, by M. Schwartz, Professor of Technology, at Stockholm, who constructed a twenty-five horse power boat engine on this principle, with the most complete success. His engine had its two cylinders and condensers, swinging side by side of each other upon solid trunnions at the lower ends of the cylinders and condensers. There was, therefore, no difficulty in effecting condensation. The steam was admitted thro' the stuffing boxes placed close to the trunnions. The connection of the air pump placed between the cylinder and condensers was also effected in a similar manner. About five years ago this gentleman came to England, and Mr. Gill submitted his plans to most of the engineers in the metropolis, but no one would take it up. Recently, however, Messrs. Penn, the engineers, of Greenwich, have fitted many boats with oscillating engines, but have not, by all accounts, adopted all the improvements which M. Schwartz proposed. Mr. G. states the advantage of these boat engines to consist in their compactness and admirable disposition of weight, which also answers all the purposes of ballasting. Their principle advantage, however, appears to be *in the cylinder playing to the circular movement of the cranks without requiring the help of parallel motions.*

A new and effectual method to Kyanize timber.—Within the last two or three weeks the Manchester and Birmingham railway company have commenced Kyanizing their wood sleepers in a much more quick and effectual manner than by the old mode of simply depositing the timber immersed in the prepared liquid. The company have made a large iron cylindrical vessel, weighing about ten tons, and which is about thirty feet long and six or seven in diameter, made from wrought iron plates, five-eights thick, and double rivetted, which vessel is capable of resisting a pressure of 250 lbs. on the inch. This vessel being filled as compactly as possible with wood sleepers, twelve inches broad and seven inches thick, the liquid is then forced in with one of Bramah's hydraulic pumps, and worked by six men to a pressure of 170 lbs. on the inch. By this means the timber is completely saturated throughout in about ten hours, which operation, on the old system, took some months to effect.

New Steam Vessel.—Experiments are in the course of being tried with the model of an entirely new form of steam vessel, and, as far as they have yet gone, with every prospect of a successful result. At present we can only state of this remarkable invention, that there are no paddle wheels, nor external works of any kind. The whole machinery is in the hold of the vessel, where a horizontal wheel is moved by the power of steam, and, acting upon a current of water, admitted by the bow and thrown off at the stern, propels the mass at a rapid rate. By a very simple contrivance of stop-cocks, etc., on the apparatus, the steamer can be turned on either course retarded, stopped, or have her motion reversed. This will be literally a revolution in the art of steam navigation.—*Hampshire Adv.*

A meeting of merchants was recently held at Trieste, at which the Archduke John presided; the object was the construction of a railroad from Trieste to Vienna. According to the plan of the engineer, Sommering, the only interruption to the line is a few miles of very mountainous country, which will be travelled by horses. At the castle of Duino, about three leagues from Trieste, the railroad will join the great Lombardy and Venetian branch. The Archduke expressed his admiration in the warmest terms; and added that it was the earnest wish of the emperor that this great desideratum should be effected, by which we may bid adieu to the shores of the Adriatic in the morning, and sleep in the Austrian imperial capital the same night.

Safety valves.—M. Sorrel has announced to the Academy of Sciences the invention of a safety valve, which, at the amount the pressure has passed a certain limit, announces the fact by a whistle, and stops the combustion of the fire by shutting a register or damper. A second, but different, sound, tells when the boiler is growing short of water.

St. Petersburgh, March 26th.—There are a great many workmen employed on the railway between Vienna and Warsaw, and we understand that no time will be lost in finishing this important undertaking.

The receipts of the Hartford and New Haven railroad for the month of May, were—

For freight, - - - - - - - - - -	$750 09
" passengers, - - - - - - - - - -	6,690 04
Total,	$7,449 13

The expenses of operating do not exceed $1,800, including repairs.

The receipts on the Norwich and Worcester railroad, during the months of April and May, amounted to $23,498 11.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 2, Vol. V. New Series. | JULY 15, 1840. | Whole No. 362. Vol. XI.

THE ELECTROTYPE.

In accordance with the prevailing spirit, for magnificent and comprehensive names, we are furnished with the above mentioned title for a process, which has been very generally noticed in its application to copying medals, copper plates, etc. We have at different times furnished our readers with notices of this discovery, and details as to the mode of operation, (see vol. IX, p. 230, vol. X, p. 50, and 299.) It has now become a matter of much interest, and bids fair to rank among the useful arts; we therefore propose to give a general idea of the principle and its applications, refering to the articles above named, for the history of its progress.

It is well known, that in all galvanic circles there must be a complete communication either by metal or conducting solutions.

The simplest instance of a galvanic circle is to be found in the well known experiment of placing a slip of copper on one side of the tongue and one of zinc on the other. No peculiarity of taste is to be remarked but on bringing the ends of the strips into contact a very peculiar taste is instantly observed. Here the mositure on the tongue is the exciting liquid which in this, and in every other case must be a conductor, and capable of being decomposed.

Again, in dilute sulphuric acid, a piece of pure zinc and another of copper may lie near each other without producing any apparent effect, but on causing the pieces to touch, either directly or through the intervention of a wire, the decomposition of the water will proceed so rapidly as to cause the mixed grains in their escape to throw the liqnid into a foam.

If a strip of zinc, and one of copper, soldered together be immersed in a solution of sulphate of copper, the solution will be decomposed, but the mixture of the products of decomposition disguises the results. If the vessel containing the solution be divided by a partition of muslin or paper, we can place on one side a solution of sulphate of copper, and on the other

either acidulated water or a solution of Glauber salt—without any danger of mixing although they are actually in contact. If the copper plate is now immersed in the solution of copper and the zinc plate in the other solution, metallic connection being established by a copper soldered to both plates, it will be found that the zinc gradually dissolves and the copper plate is covered by a deposition of pure metallic copper—while the solution in which it is immersed gradually loses its blue color. The copper deposited is in the form of crystals, but presenting a continuous surface, provided that the plate has the same; any variation in the surface of the plate will be precisely copied in the deposite, and hence the process resolves itself into what we might denominate a *cold casting of copper.*

The simplest form of this experiment, which can be tried almost for nothing, and which will amply repay the little trouble it costs, is as follows. Take a vial without a bottom, or still better, the bottom of a glass lamp chimney (the whole can be used without injuring it,) tie over the smoothest end a piece of paper very closely, place this with the covered end down, in a larger vessel. Place in the outer vessel a strong or saturated solution of sulphate of copper (blue vitriol) and in the inner vessel, water to the same level, into which a little glauber salt, sal ammoniac, or common salt must be thrown. Let a strip of clean copper be placed in the outer solution and a strip of zinc in the inner one with their ends projecting above the glass, and united by a copper wire bound tightly around, or soldered to each. If the apparatus is now placed in any convenient position for observation and where the liquid will not evaporate too rapidly, it will be found that the zinc dissolves, the blue color of the copper solution gradually disappears and brilliant crystals of copper cover the entire surface of the copper strip. At the conclusion of the experiment, which will be in one, two or more days, according to the quantity of sulp. of copper employed, the plates may be taken out, and by using a little force the copper coating may be nearly all removed, when it will be found to have faithfully copied all the minute scratches and irregularities of the surface of the plate.

A stil more simple modification of this experiment, when small quantities only are used, consists in employing the bowl of a common tobacco pipe with the hole at the bottom stopped with a bit of wax, this furnishes the inner vessel which is porous over its whole surface. It may be placed in a wine glass or any other convenient vessel, and the solutions and metals arranged before, we may however dispense with a copper plate by immersing a coil or even simply one end of the copper wire used to form the union with the zinc. With the bowl of a common tobacco pipe (with the hole closed,) a wine glass, a piece of blue vitriol as large as a pigeon's egg, a piece of sheet zinc as large as can cover the little finger and five or six inches of copper wire or a narrow strip of sheet lead—this interesting experiment can be prepared in a few minutes, and will afford the most complete satisfaction.

In the useful application of this experiment, it has been found advisable

to use plaster of Paris as a porous diaphragm instead of paper, but the principle and general arrangement remain unaltered. For a minute detail of the best mode of preparing the apparatus for coppying medals, etc., we refer our readers to the very excellent and yet plain directions of Mr. Spencer, the inventor, vol. X, p. 300.

In coppying medals, the inventor purposes to place the medal between two pieces of sheet lead and subject the whole to a powerful pressure. In this manner a complete matrix is obtained, giving the minutest lines on the surface of the copper. One of these leaden matrices is next to be soldered to a copper wire as above, and placed in the copper solution, the zinc remaining the same as before. The copper is then gradually deposited upon the lead, and the fac simile of the medal thus formed.

It is obvious that a matrix of coper may be made at once from the medal and this copied again by the same process. In this case, however, there is a risk of the adhesion of the copper, unless means are taken to prevent it. The different expansibilities of lead and copper allow of their easy removal when in the most exact contact.

By these same methods copper plates may be coppied to an indefinite extent without losing any of the lines of the original. The London Journal of April last, contains two impressions side by side one from an etching after Rembrandt, the other from the copied plate obtained by the method last mentioned, which includes two electrotype transfers of the design, and yet there is no difference, save in the printing, that can be detected by a magnifier.

Yet another method is that of Jacobi, he uses fusible metal to obtain the matrix and deposites the copper upon this. We have examined a medallion head of Thorwaldsen copied in this manner by Dr. Jacobi himself, and which presents the utmost shapeness and clearness which can be imagined. We have also examined a head of Franklin, copied by Franklin Peale, Esq. of Philadelphia, in which notwithstanding its great size there could not be found a blemish.

Having thus reviewed what has been done, let us proceed to a consideration of what may still further be accomplished.

The stereotyping in copper any wood cut designs is perfectly analogous to the process for copying medals, etc. It is also very possible that designs may be executed at once in copper with great facility and without costing as much as wood cuts, and possessing in common with them the advantage of not requiring a separate press but admitting of being worked in with letter press. The process would be somewhat such as this. Prepare a perfectly smooth plate of lead, cover it to a uniform thickness with wax, upon this write or draw the design directly, and without reversing—cut the design thus traced down to the lead—immerse the plate for a short time in dilute nitric acid and then place it in the solution forming contact as before. The copper is deposited at once in the form intended to be used. A drawing of the apparatus used in the electrotype, has been engraved by the in

ventor in this manner and resembles a wood cut. We have thus a means by which a tolerable draughtsman may at a very trifling expense furnish cuts of the most elaborate designs, ready for the printers' use.

It is true that this branch of the invention has not yet attained the perfection which its earlier applications have reached, but it is to be remembered that while the one attempts to furnish a new mode of publishing original designs, the other aims only at copying those already executed.

It is this application of the art which we think promises the most useful and widely extended results.

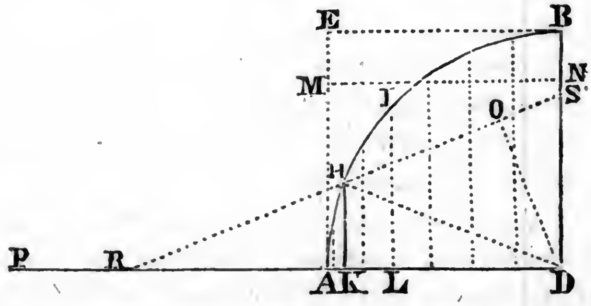
There is, however, another use to which the electrotype can be put which we have not seen even hinted at; it is this—we can with a very little contrivance, execute such parts of delicate machinery and apparatus as can be made of copper—by means of a model, without the use of any cutting instrument or other tools for working in metal. When it is recollected that copper precipitated in this manner is harder than when cast, it is easy to conceive of many cases in which it may replace brass.

The whole subject, however, is full of interest, and we might weary out our readers with a list of suggested applications, which, however, we leave each one to form for himself. We feel strongly inclined to suspect that in general practicability and usefulness, this art will excel its more famous rival the Daguerreotype.

If one use alone can be made of it, viz. to afford a cheap and expeditious means of executing diagrams, maps and other professional designs we shall be satisfied, and we hope that it will afford us the means of frequently gratifying our readers with cuts from which we are obliged to abstain on account of the high price of wood engraving.

THEORY OF THE CRANK.

Fig. 1.

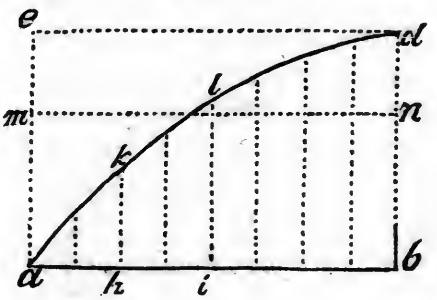


Let D, Fig. 1 represent the centre of motion, and AIB one fourth of the circumference of the circle, described by the crank. Suppose, also, the moving power to act in a direction *parallel* with the line PD, and with the same intensity at all points. The effect of the power at any point, in causing the crank to revolve is in proportion to the distance of the line of its direction from the centre of motion. Thus, in passing from A to B, the effect increases in the proportion of the ordinates HK, IL, etc. From B

through the next quadrant the effect is diminished in the same proportion. In passing the third quadrant it is again increased, and in the fourth quadrant diminished in a similar manner.

The several ordinates HK, IL, BD, etc., may be considered as representing the different levers with which the power acts, and as the sum of all the ordinates inscribed in the quadrant ABD is equal to the area of the quadrant, by dividing that area by AD, the quotient exhibits the mean or average length of the several levers, equal to the height DN of a rectangle AN, whose area is equal to that of the quadrant. If AD=1, DN, will be found by calculation to be equal to ·7854. Although DN, is the mean length of the several levers with which the power acts, it must not in estimating the effect of the power be taken as representing the *mean leverage.*

Fig. 2.



It may with propriety be assumed that the motion of the crank is uniform, since in a train of railway cars under motion, the momentum of the moving mass is so great as to counteract the tendencies to irregularity. Hence the crank in moving from A to B, has an uniform motion, passing over equal portions of the arc in equal times. Make the line *ab,* in Fig. 2, equal in length to the arc AB, in Fig. 1, and suppose ordinates to be erected from the several points between *a* and *b*, equal in length to those drawn from corresponding points in the quadrant. That is, *ah,* and *ai* being equal respectively to AH and AI, make *hk*=HK and *il*=IL, also *db* =DB, etc. From *a* through tho points *k, l,* etc., draw the curve line *a, k l, d.* As the crank in passing with an uniform motion from A to B, or its equal *ab,* acts with the different levers represented by the ordinates drawn to the several points, it follows that the area of the figure *aldb* represents correctly the sum of all the different levers upon each of which the power operates an equal length of time; and hence, dividing by *ab* gives the height *bn* of a rectangle equal to that area; consequently *bn* is the *true mean leverage* of the crank for the quadrant AB, and for the reason above assigned is also the mean leverage for each of the other quadrants.

It will be found by calculation, that if *ab* be taken equal to unity, that *bn* is equal ·636+. Consequently the power acts with a force or produces an effect equivalent to that which it would produce if operating constantly at right angles to, and at the extremity of, a crank whose length is .636+.

It will be found that this decimal is the same with that of the ratio of the circumference of a circle, to twice its diameter, and as these quantities are the measures respectively of the velocities of the extremity of the crank, where the power is applied, and of the motive power, it follows that the *principle of virtual velocities* is true in its application to the movement of the crank under the circumstances as assumed.

Where the power operates through the medium of connecting rods as in locomotive engines, the effect of the arrangement is to increase the leverage at certain points, and diminish it at others. The least length which a connecting rod may have is that of the length or *throw* of the crank; that is, it can never be less than AD, or BD.

Assuming the rod to be of this length, the leverage with which the power acts, is easily ascertained—suppose in Fig. 1, RH, to be the position of the rod. Produce RH, to S, and from D, perpendicular thereto draw DO—draw also HD. The power acting in the direction PD, produces an effect in the direction of RH, according to the principles of the resolution of forces, represented by the ratio of RK to RH. The leverage with which the force in the direction RH acts, is obviously correctly represented by the line DO. The actual leverage with which the moving power acts is greater than OD, and bears therefore, the same relation to OD, as RH to RK. By geom. RK : RH : : OD : DS. DS, is therefore the leverage with which the power acts when the rod is in the position RH, and in general, *the leverage for any position of the rod, while the crank is passing from A to B, is correctly represented by the distance from D to the point where the line of the rod produced, intersects the perpendicular raised from D.*

Again, as RH is assumed equal to HD, the line RK is equal to RD, and by geom. DS is equal to twice HK. But HK is shown above to be the leverage, when the power acts upon the crank parallel to PD. Hence, in describing the quadrant AB, the actual leverage with which the power acts at any point, when the connecting rod is at its minimum length is just *double* what the leverage is at the same point, when the power acts upon the crank in a direction parallel to PD. By a little reflection it will be seen that when the connecting rod is at its minimum length, it remains stationary with its extremity R at D, during half the revolution of the crank. There is, therefore, no power exerted during that time in forcing the crank forward, the power being exerted wholly in the first and fourth quadrants. Inasmuch, however, as the average leverage for the half of the revolution in which it does operate, is just double that for the whole revolution, when the power acts in parrallel lines as demonstrated above, the result is the same in each case. In like manner it may be shown that the result is the same for any length of rod greater than AD.

So far therefore as respects the moving power, nothing is lost in the use of the connecting rod, the result being in all cases in strict ac-

cordance with the principle of *virtual velocities.* ***Practically,*** however, there are advantages in the use of *a longer* rod. The sliding friction is diminished as the angle at R is lessened, the greater elasticity of a longer rod, is of use perhaps, in overcoming the inequalities of the resistance. In proportion also as the rod is increased in length, the effect of the power is more equably distributed throughout the whole revolution of the crank. It can, however, never become the same in each quadrant, since to accomplish it, the power must act upon the crank at all points parallel with PD—a condition inconsistent with the use of the connecting rod.

TWO REPORTS ON THE COAL LANDS, MINES AND IMPROVEMENTS OF *the Dauphin and Susquehanna coal company, and of the Geological examination, present condition and prospects of the Stony creek coal estate, etc.* ***Pennsylvania*** *; with an appendix containing numerous tables, and statistical information, and various maps, sections and diagrams, chiefly in illustration of coal and iron. Addressed to the board of directors of the Dauphin and Susquehanna coal company, and to the trustees of the Stony creek coal estate.* By Richard C. Taylor, President of the board of directors.

We have been favored by the politeness of the author, with a copy of this report, comprising 187 pages of letter press, and a number of diagrams. We have seldom read anything of this kind, which has given us so much pleasure and instruction. The object of this report is to unfold the prospects and resources of the above named coal tracts, but contains a vast amount of general information on the coal and iron trade far exceeding what is to be found elsewhere condensed into the same space.

The striking feature in this document, is the scientific accuracy displayed throughout its pages. The basis of the report is a careful geological examination of the tracts and the surrounding country, and the candid and impartial tone of the language strikes as giving great authority to its statements.

The coal of this region is the most southern in this part of Pennsylvania, and consequently the nearest to tide water. It approaches the Susquehanna a few miles from Harrisburgh, and requires but 93 miles carriage to Havre-de-Grace, at the head of tide water on the Susquehanna. A remarkable circumstance in regard to these coal fields, is the gradual and almost imperceptible transition from bituminous to anthracite coal. This, in connection with the occurrence of excellent iron ore, has caused Stony creek to be named as a position for a national foundery.

Of the value of this region, the following among other testimonials, is given in the report.

In a printed circular, by Professor Renwick, dated Columbia College, New York, 1832, the writer observes: "the bituminous coal (of Stony Creek) is yet known principally by its analysis. Should this coal be found to be as abundant as there is every reason to believe, the portion of the lands that contain it, cannot fail to acquire a value beyond all cal-

culation; for it will afford facilities for the manufacture of iron equal to those proposed in the most favourable positions in Great Britain; and would enable that important article to compete with the European, without the aid of any protective duty."

We close with the following extract, but propose at our next opportunity to gleam from this report some items of interest on the coal trade.

ADAPTATION OF STONY CREEK VALLEY AS A SITE FOR A NATIONAL FOUNDERY.

Among the various positions named for the site of a *National Foundery*, that of Stony Creek has recommendations superior to most, perhaps to all others, that have been mentioned for this purpose. We may recount among the facilities offered by this location.

I. That of uninterrupted canal transportation for boats carrying from 60 to 80 tons, to tide water at Havre de Grace; the distance of 80 miles being sufficient to secure this position from any sudden hostile approach of an invading enemy.

II. That of continuous canal and railroad transportation up the Susquehanna and its tributaries and intersecting lines of communication to the north, and the east, and the west; from the Ohio to the Hudson; from the Chesapeake and Delaware to the Lake frontier.

III. That of ready access to the seat of government.

IV. Its immediate location in the midst of that description of coal which is declared to be the best adapted to the objects required; which coal is divisible into the following modifications, viz:

1. The soft blazing coal of Short mountain, capabable of ng coked.

2. The bituminous and somewhat harder coal of Rattling Rum.

3. The four varieties of still more compact bituminous coal of Yellow Springs.

4. The intermediate or transition coal, consisting of eight or more veins at Rausch Gap, all in some respects varying from each other.

5. The free burning anthracite, approaching to coke, or more highly carbonized coal of Gold-mine Gap, Mount Eagle, and Black Spring Gap; fourteen veins, all having perceptible differences in quality and structure.

V. Its facilities for obtaining several varieties of iron ore, as follows:

1. The brown, red, and black hæmatites, from near Columbia, by Pennsylvania canal, 40 miles to the south.

2. The calcareous red oxide of iron from Danville, 60 miles, and from Bloomsburg, 71 miles to the north, by Pennsylvania canal; also

3. The argillaceous carbonate of iron in seams, accompanying the coal veins here.

4. The excellent bog ore, hydrate of iron, also in the coal region of Stony Creek.

5. The red siliceous iron ore of Short mountain.

VI. The water power of Stony Creek, for which sites present themselves at nearly every half mile for 15 to 20 miles.

VII. The abundance of timber for lumber and for charcoal, extending along nearly the entire length of Stony Creek Valley, and the consequent cheapness of fuel. If for certain purposes, charcoal iron be considered indispensable, the wood of 60,000 acres is attainable.

All other considerations are comparatively unimportant after those enumerated under the seven preceding heads. To these, however, we are enabled to add other desiderata, to which, in the selection of a site for a public

work of this kind, some degree of consequence has elsewhere been attached. These are

VIII. A favourable site for the proving of cannon: and here the slopes of Short and Second mountain present innumerable positions.

IX. Fire clay for bricks, linings, crucibles, &c., required in such a work, abounds in the argillaceous strata of this region. Limestone for flux, eight miles below Stony Creek. Plastic clay, for common bricks, occurs along the valley.

X. Facility of procuring provisions and other necessaries of life; being on the main avenue along which passes the grain, flour, corn, pork, and other agricultural productions of an immense region bordering on the Susquehanna and its tributaries, and even extending far westward beyond the Alleghany mountains. Little need be said about sufficiency of labouring population; because it is a fluctuating body, moving always in the direction of demand and remuneration, and will probably always be equal here to the required amount.

XI. The town of Port Lyon or Dauphin, and the valley of Stony Creek, afford appropriate and healthy sites for the residence of a working population, to almost any imaginable extent.

XII. Low prices of coal and iron are necessarily consequent to the state of things noted in IV. and V. There are several furnaces, forges and rolling mills already established in the vicinity of Stony Creek; from these additional supplies of excellent pig iron can be obtained.

In one or more of the sites most strongly recommended for a national foundery, it is stated that the coal will have to be brought from the mountains by rail-roads and canal, 200 miles, and the iron ore and pig iron 70, and 120 miles. *Here* both these ingredients, possessing every gradation of quality, exist upon the spot.

THE AMERICAN REPERTORY OF ARTS, SCIENCES AND MANUFACTURES.

Edited by James J. Mapes.

We have received Nos. 1 to 5, of this work, which has lately made its appearance as a monthly Journal. Judging from the numbers already before the public, the work appears very well both in point of varity of matter, and neatness of execution. It is proposed to increase the interest in this Journal by reporting the transactions of several societies, chiefly however of the Mechanics' Institute. We hope that it will be better rewarded for the great pains bestowed upon it, than the former proprietors of this work were by thier connection with the same Institute. We understand, however, that the difficulties then existing have been done away with; in that event we can reasonably expect a fair encouragement to the American Repertory.

AUTOGENOUS SOLDERING.

A new process bearing this grandiloquent title, is at present exciting much attention both in England and in France. It is the invention of a Mr. Richemont, and consists in part of a blowpipe, attached to a self regulating reservoir of hydrogen gas, and supplied likewise with common air near the get. *No solder is used,* but the beat of the blowpipe is sufficient to cause the fusion of the metal, and the consequence is the absence of any

joint or seam. The expense of the materials as is well known is a trifle; sulphuric acid and zinc, cost but little, and the resulting sulphate of zinc goes a greatway to pay the cost of them.

The advantages of such a mode of uniting metals, are much greater than would at first be imagined. In the case of lead alone, the saving would be immense, for the galvanic action attendant upon the presence of another metal, so highly exalts the action of any slightly corrosive substance, that in various branches of manufacture, leaden vessels are absolutely discarded, or used at a great cost, simply because they involve the presence of solder.

An important use of this invention is to the soldering of the tubes of locommotive boilers,—the perfect control and management of the flame, giving it a great advantage. There can be no patent for the process in this country—the mode of operation is very simple, and we should be pleased to hear that some of our enterprising manufacturers had tried the experiment.

It is but justice to add, that Mr. Spencer the inventor of the electrotype, claims to have used this plan of soldering and to have made it known to his friends long before the date of the French patent.

ERRATA.—In number 12, vol. IV, New Series, page 362, ninth line from bottom, for "wild *grapes* of the Pontoosuc," read "wild *gorges* of the Pontoosuc."

Railroads.— An article is going the rounds, stating the cost of several of our first and most important railroads. Without explanation it may tend to deceive the public, as to the actual cost, at the present time, of a well constructed railway.

The roads named in the list were generally our first essays and lessons in railroad construction, with expensive inclined planes on a part of the roads named, broken stone foundations, &c. They have generally double tracks, where single tracks, with suitable turnouts, would have answered every purpose, in the present state of travel and traffic. And last, though not least, these roads have cost extra rates per mile, by beginning at the wrong end of making a railway, viz. by commencing the work and calling in capital, before the "right of way," or road bed, on which to construct the road, is first obtained on the choice of the several routes on which it is proposed to construct the road, for the selection of the directors, of the best and least expensive line.

The land for the right of way, and damages (!) on the roads named, have varied from $2,000 to $8,000 per mile, and this on lines where the construction of this new class of improvement has generally added greatly to the value of the property of the farming interest. On the Long Island Railroad, and other roads named in the list, the right of way has cost the stockholders, by a premature location and bad management, near $8,000 per mile. On the Utica and Schenectady Railroad (with damages for the turnpike) the right of way cost about $5,000 per mile, as the road was located by law. This item off from the cost of this road, $19,000 per mile as stated, reduces the same to $14,000 per mile.

On lines where railroads do not cross ridges, and there is not heavy rock

blasting and high embankments, the cost at the present time, for a single track, with the flat and T rails may be stated in round numbers, at from $14,000 per mile for the flat, and $20,000 for the T rail.

The item of $40,000 per mile in the list for the Camden and Amboy is calculated to deceive. That road has a double track and the T rail on a large portion of the road. About $400,000 were paid for land and damages; also about $450,000 for steamboats on the Delaware and at this end of the route. These items taken off, this road costs for a *double* track, depot, an expensive manufactory of locomotives, and for repairs, with other fixtures, less than $25,000 per mile. A contract to test the cost of the first five miles of the New York and Albany Railroad, over the worst average of the road, proves that it may be constructed and put in operation for $15,000 per mile. The N. Y. and Erie Railroad calculate on $10,000 per mile; in this estimate they may be disappointed. J. E. B.

INSTITUTION OF CIVIL ENGINEERS.

(Continued from page 29.)

The preceding results show also that errors have crept in by the adoption of the theoretical method of reducing undulatory surfaces to a level. M. de Pambour extends the length of the road as a compensation for the acclivities or for the help afforded by the bank engines, and Dr. Lardner diminishes the time of the trip to that which he assumes would be occupied in performing it on a dead level. If the principles on which these corrections for the acclivities and declivities are made, be correct, other facts than we are at present acquainted with must be taken into account before it can be demonstrated that a given power will convey a given load at some certain increased velocity along any given undulating line. The resistances which enter into the composition of the sum of the forces are ever varying to such an extent, that it may be doubted whether the the theoretical level be not a pure fiction with reference to the practical results of the experiment.

The effective power of a locomotive engine, or the excess of power after overcoming its proper friction and the resistance from the blast, is solely expended in the generation of momentum. This which is the product of the mass and the velocity represents the useful mechanical effort exerted by the steam, and may always be ascertained under all the practical circumstances of railway traffic. The consumption of power as water, in the shape of steam, is a third quality which may be also readily ascertained. The application of which may be made of the above data is comprehended in the following propositions. First, that equal momenta would result at all velocities from an equal amount of power expended in equal times by the same engine, if the forces opposed to progressive motion and to the effective use of steam in the engines were uniform at all velocities. Secondly, the difference between the momenta generated by a unit of power in a given time at various velocities, measures the difference in the sum of the resistances opposed to the power at those velocities. Having ascertained the gross weight of an engine tender and train—their mean velocity—and the expenditure of water as steam during the trip, simple computations will inform us of—

1. The mechanical effect realized by a given power at all velocities.

2. The total increase or decrease of resistance at all velocities.

3. The ratios which the increase or decrease of resistance at different velocities bear to the ratios of these velocities.

Two other results also follow from the above, and which may be termed the commercial results, viz., the amount of gross and useful tractive effect realized by an equal expenditure of power at all velocities. The difference between these is a useless quantity in a practical sense, being the costly waste of power incident to the locomotive functions of the engine and tender over and above the waste arising from the unascertained and ineffective portion of the whole power required for the blast. The reductions and computations necessary for the exhibition and development of these views are contained in two tables. They relate to forty-nine experiments, being those already referred to, and those by Mr. N. Wood, on the Great Western, and London and Birmingham Railway, and some others. One of these tables contains the velocity of the engines, the consumption of water as steam, the loads, the absolute momenta per second; the momenta generated by equal power in equal times, viz., by 1 lb. of water as steam per second; the weights of the gross and useful loads moved by equal powers, viz., by one cubic foot of water as steam, at the velocity of each experiment, with various other elements. The other table contains a summary of the ratios of the velocities and of their squares, brought into juxta-position with the ratios of the power expended to produce equal momenta, equal gross and equal useful effects, by the comparison of pairs of experiments on the engines given in the preceding table. This table also shows the influence of velocity in the expenditure of power to produce equal mechanical and equal commercial effects; and the amount of loss attributable to the increase of resistance at the higher velocities. The author discusses in great detail the various circumstances of these experiments, and the inferences and practical conclusions which may be deduced therefrom; and comes to the conclusion, that the determination of the performance of locomotive engines by the methods here set forth, is as practicable, exact, and demonstrative of the relative powers and dynamic excellence, as to the determination of duty done by pumping engines.

The intensity of the pressure on the opposite side of the piston arising from the blast has been but imperfectly stated. By some, the discharge of the steam has been likened to a jet, and considered continuous. But an attentive observer can appreciate by his ear that an interval exists between the alternate discharges of steam from the two cylinders. That these jets are periodic and not continuous, is also distinctly evidenced by the audible pulsations in the chimney, even at the very highest velocities of an engine, and their duration may be measured at lower speeds. Upon this intermittent action of the blast depend, in a great measure, the resultant pressure against the piston, and the production of a sufficient current of air through the fire, both which effects would be materially changed in intensity by the substitution of a continuous for a periodic current. The precise duration of the jet, or of the time of the steam evacuating the cylinder, can only be determined by direct and careful experiments; bu its period may be ascertained within definite limits; for since a single discharge is completed within the time occupied by the piston in accomplishing a half stroke, and the pauses between the two successive discharges are distinctly perceptible, a single blast cannot occupy the fourth part of the time of the revolution of the crank shaft, and very probably does not exceed the eighth part, or the period of a quarter stroke of the piston. Under no circumstances, then, can the pressure from the blast oppose the piston much longer than during one fourth of the stroke. With an active pressure, then, of 30 lbs. per square inch, the mean resistance from the blast would not be greater than 7½ lbs., and with a pressure of 15 lbs., not

greater than $3\frac{3}{4}$ lbs. per square inch, against the pistons. The author then proceeds to cite several observations and experiments made by himself, which are confirmatory of the preceding argument respecting the blast, and he was led conclusively to the fact, that $\frac{1}{5}$th of the power of the engine experimented upon, at working pressures of 20 lbs. and 15 lbs., was absorbed in blowing the fire; and the escape of the steam from the cylinder was four times swifter than the motion of the piston.

The author lastly treats of the expenditure of power for a given effect by fixed and locomotive non-condensing engines. But few experiments on the expenditure of steam for a given effect by non-condensing stationary engines have been made. The relative consumption of fixed condensing and non-condensing engines have been treated of by the late Mr. Charles Sylvester, of Derby, whose knowledge and accurate theoretical analysis of the subject are shown by the close accordance of his conclusions with the facts established on two engines of these classes at certain working pressures. His conclusion that the relative economy of these engines will be as the quantities of steam consumed, or as 2 to 1.72, at those pressures, is accurately confirmed by the results here recorded. Mr. Sylvester also showed, that by increasing the pressure upon the same non-condensing engine's cylinder and air pump, so as to maintain the steam in it at a uniform pressure per square inch for all loads, the economy of the former would gradually approach and finally equal the latter. The results obtained in the preceding part of the paper furnish numerous comparisons between the locomotives and fixed non-condensing engines, and the consumption of the latter has been used, together with the condensing engine, as the test of the accuracy of the data of resistance assigned to the former by the various analysts. The accurate determination of the expenditure of steam by the same locomotive engine, in which the values of the friction and of the blast pressure were ascertained, admits of the consumption of water as steam for given effects being determined, and thus narrows the grounds of doubt, and establishes more correct data for ascertaining the real resistance opposed to progressive motion on railways. The application of these principles, as borne out by the experiments of the author, and their particular bearing on the experiments which have been the subject of the previous ample and detailed discussion, form the conclusion of Mr. Parke's series of communications on steam boilers and steam engines.

PLAN TO PREVENT THE FALL OF A MINE BUCKET IN CASE OF THE ROPE BREAKING.

Sir,—The year before last, I sent to the exhibition of the Royal Cornwall Polytechnic Society a model of a plan for raising miners, which I had previously submitted to the inspection of several practical men, who had all expressed a very high opinion of its merits. It was not, however, considered worthy the notice of the judges, and passed the exhibition without any observation. I feel every disposition to rely on the correctness of the decision, come to on that occasion; but yet, as in a greater multitude of councillors there may be more wisdom; and as, while I see the life of the miner most awfully shortened by his occupation, and while I have observserved on examination of the burial register of a neighboring parish, that $16\frac{1}{4}$ *per cent. of the deaths of miners during two years have been accidental,* I see no plan as yet at all likely to be carried into effect, to ameliorate their condition. I feel a great desire to have the opinion of some of your very ingenious and scientifically competent correspondents on the subject.

My plan was that a bucket of any convenient dimensions should be provided with projections on each side to run in grooves, firmly fixed on each side of the whole depth of the shaft. In the same manner, I believe, as the corves in some of the coal mines. I proposed to have the back of some of these grooves constructed like ladders, and furnished with strong and well-secured iron staves. To the upper end of each of the vertical projections of the bucket, were to be fixed by moveable joints, one or more strong crooks, acted on by powerful springs, which should continually press them, with great force, towards the staves in the back of the grooves. On the back of each of these crooks was to be fixed a very strong ring connected by chains or ropes to the principal chain or rope used to raise or lower the bucket. As long as the tension of the main rope continued these crooks would incline inwards over the iron roof of the safety bucket; but in case of the rope breaking, and the consequent removal of its restraint, the springs would force the crooks upon the staves, and the buchet remain suspended until another rope was affixed. I will not enter more minutely into a description of my plan, the model of which worked in the most satisfactory manner, and will only beg to ask the opinion of any of your correspondents in the coal districts as to the practicability of its introduction in grooved shafts already constructed, and to solicit any competent opinions on its suitability, or otherwise, to the purpose for which it was suggested.

I very much fear that unless the press take up the subject, very little benefit will result to our deserving, but much suffering mining population from the annual exhibitions of the Polytechnic Society; and I should rejoice to see your influential journal enlisted with that society in its benevolent efforts in behalf of our working classes.

I remain, Sir, very truly yours,

R. Blee, Jun.

Redruth, Dec. 30th, 1839.

TO THE SENATE AND HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA, IN CONGRESS ASSEMBLED:—*the memorial of Edmund Pendleton Gaines, Major General in the Army of the United States, commanding the Western Division, respectfully showeth that—*

(Continued from page 21.)

16. *Operations in the final construction of the work.*

Each one of the proposed routes to be placed in charge of a Colonel, who will superintend the construction of the work; and for the prompt and convenient accomplishment of every part of the work, each route will be subdivided into *ten sections*, and each section placed under the immediate superintendence of a Captain, to be assisted by the whole of the subaltern officers, non-commissioned officers, artificers and privates of the company, with as many volunteer artificers and other operatives as will be sufficient to ensure the completion of each section in from four to five years after the location of the work, which may be accomplished in one year. So that when one section of sixty miles in length is completed, the whole work will be quite, or nearly finished;—with the exception of that which is unavoidably located over a mountainous country. The completion of the mountainous sections may be hastened by such increased means, as the exigencies of the service shall demand. The simple process of carrying on such a work, necessarily increases the *means* and *facilities* of its progress and speedy accomplishment. Thousands of our young men ignorant of every operation upon the work will soon become able operatives. To the regular army we should have the power to add every scientific *me-*

chanic, artificer, and able bodied willing laborer, to be employed as *volunteers,* principally within the limits of the States where the sections of the railroads on which they are to be employed, respectively, are located and constructed; so that the services of all may be near their places of residence. We shall thus call into action and usefulness that class of American genius which would otherwise, to a greatextent, languish and fall into the whirlpools of vice or imbecility for want of employment and judicious direction—that genius which is found in the learned professions, in all the walks of fashionable life, in the pursuits of Agriculture, Commerce, and the Mechanic Arts, as well as in the haunts of dissipation and idleness; whose votaries may indeed often too truly say, "we are idle because no man hath given us employment." By these idlers, whose employment would save them from misery and ruin, and render them valuable citizens, and enable them to render their country invulnerable in war, and enrich it in peace,—aided by the enterprising young men which every section of the Republic is capable of affording for the proposed great work, and arming with the irresistible weapons of industry and enterprise, necessary to enable them in obedience to the sublime mandate of Holy Writ: "to replenish the earth, and subdue it," and render it fruitful, that it may multiply the benefits and blessings which it is capable of yielding to man, the proposed work will be speedily accomplished.

17. The hidden wealth which the progress of the work will disclose, added to the vast supplies of materials for construction, for transportion, and for food and raiment for the operatives upon the work and for commerce —supplies, a considerable part of which every year waste away among the interior sections of the Western and Middle States for want of a cheap conveyance to good markets, such as the proposed railroad will afford, will contribute much towards the completion and final profitable employment of the work;—supplies that would every year be augmented by new improvements, and by encouraged industry, until they would far surpass the immediate wants of the great and increasing influx of population, and operatives upon the public works, and frontier; and on the completion of the work, these constantly increasing supplies would be poured into the improved channels of cheap transportation and profitable commerce—gradually swelling the profits of both, as the millions of tributary rills and rivulets expand the mighty river into whose bosom they pour their liquid treasures. It is believed, moreover, that the construction of the proposed railroads through the Southern, Western, and Atlantic States, would not fail to create the means for the speedy completion of all the latteral branches required for every State and seaport, by multiplying among us experienced engineers, and scientific mechanics, with habits of industry and enterprise; giving to all classes of the community profitable employment, calculated to render them independent in their domestic affairs, respectable and happy in peace, and formidable in war—whilst the money expended would be kept in a healthy state of circulation among the farmers, merchants and mechanics of our interior settlements, in place of its being carried off to enrich foreign merchants, or to form every year at home a new bone of contention, between the votaries of the spirit of party—such as go all lengths for party men, regardless of the true interests and honor of the Republic. And when, during a state of war with nations surpassing in naval strength, we find ourselves compelled to abandon the ocean, and be deprived of our foreign commerce—the inevitable consequence of a war with any of the strong powers of Europe without first supplying ourselves with a fleet of steam ships of war, as well as floating batteries and the proposed railroads, —these roads, even while occasionally employed in the transportation of

troops from the central States to the South, will take return cargoes of Southern products, such as sugar, cotton, oranges and lemons, from the Southern to the Middle and Northern States—from whence they will bring return cargoes of the numerous products and manufactured articles of the northern and central States, needed in the South;—an interior commercial intercourse by which the privations of our foreign commerce would be remedied, and many of the evils of war removed, and all others greatly mitigated. Indeed the completion of the proposed rail roadsand floating batteries, your memorialist believes, would soon effectually prevent the recurrence of war, so long as the United States shall see fit to confine their views and national policy to the *magnanimous principle of* DEFENSIVE WAR: as the proposed means of national defence would give a degree of available strength, both physical and moral, that would render the peril of an attack a perpetual source of terror to our evil disposed neighbors; and consequent *moral strength and security* to our beloved country. * *

19. Ancient and modern history is replete with evidences of the wisest of governments having promptly availed themselves of the use of every description of *weapon*, deemed to be most formidable in war; as well as of every kind of *power* applicable to the purposes of rapidly wielding armies and munitions of war, as soon as practicable after their discovery. We need only advert here to some few discoveries, which, trifling as the first and third may seem, were deemed sufficient at the time of their discovery to merit the attention of men and monarchs of profound wisdom and genius.

First. When the commanders of the armies of King David reported to that veteran monarch, that they had sustained heavy losses in their operations against the Philistines, in consequence of their having employed in battle the *bow and arrow;* David promptly gave orders to his commanders, to avail themselves of the discovery of this then formidable weapon, and make themselves and their men acquainted with the use of it—"so as to place them on an equal footing with their enemy." (See the "History of the Bible," page —.)

Second. When in the 14th century an obscure monk of Germany discovered gunpowder, with some of its uses in war, all the other nations of Europe that were blessed with wise rulers hastened to avail themselves of the discovery—a discovery which ere long induced all the civilized world to change their unwieldy weapons of war for fire arms; gradually laying aside their *war-chariots armed with scythes, battering rams*, with their coat of mail, and most of their personal armor.

Third. The use of *wheel carriages* on improved roads added more than twenty-five per cent to the efficiency of an army, by enabling it to march one fourth further in a given time, and by carrying with it a more ample supply of artillery, ammunition and subsistence, prolonging the period of active operations, and occasionally taking the enemy by surprise; as, by the increased celerity of his movements, Napoleon took the enemies of France by surprise in his first campaign into Italy.

Fourth. All civilized nations speedily availed themselves of the discovery of the *magnetic needle*, with the inventions and improvements in *ship building, the use of sails*, &c., &c. Many of the discoveries here alluded to. however, though they contributed to facilitate the movement of troops and munitions of war, excited little or no interest at the time of their discovery, compared with that of the application of steam power to ships and other vessels, and to vehicles of land transportation on railroads. In these last discoveries we may well be allowed to speak in the language of poetry, and say that

Steam power "was almighty in its birth;"

whilst gunpowder, fire arms, wheel carriages, and all former improvements in marine structures, though partially known and in use for centuries past, have exhibited little or nothing beyond their now apparent state of infancy until within the last and present century. Even now, no civilized nation can boast of any discovery or improvement in fire arms, gun carriages, or in naval architecture, in any wise calculated to be of any *peculiar advantage* to any one nation over another nation; whilst these developments of steam, with floating batteries and rail roads, are calculated to render a nation in the position which we occupy, at least ten times more formidable in a *war of self-defence*, than in *an offensive war*, against nations of equal numercial strength, and provided with the means here proposed. All the discoveries above referred to in the science of war have, however, contributed much to ameliorate the condition of nations, and of armies, in their conflicts and controversies; and greatly to lessen the evils of war. The greater the improvement in this awful and sublime science, the less calamitous, and the more humane have been the results of military operations—wherever the contending parties were equally acquainted with the progressive improvements, and had equal, or nearly equal means of profiting by them. If these propositions are correct—and history proves them to be strictly true—where, it may be asked, where must our improvements in the science of war, dependant on steam power, terminate? The wise and the good who have long cherished the prospect of a blessed *millenium*, will readily answer the question. * * *

24. The apprehended *expense* of the proposed work, constitutes the principal objection advanced by any statesman; or by any man of military mind, whose opinions have come to the knowledge of your memorialist. To this objection it may be answered.

First—That the apprehended appropriations to meet the expense, will be no more than eleven millions of dollars a year, for a period of six years—provided the work is done by the Army of the United States as heretofore suggested.

Second—The employment of the Army upon the work will be to the officers and men, and to the youth of every State and district through which the work will extend, *the best of all possible schools* to prepare them for the defence of the country: as the officers and men so employed will have the proud satisfaction of knowing that every day's labor, in this essential work of preparation, will contribute to increase their moral and physical capacities for usefulness and domestic happiness in peace, and for a glorious triumph over the invading foe in war.

Third—In exhibiting the cost of this system of defence, it is gratifying to find that of the $66,000,000, which is the estimated amount required for the seven railroads from the central States to the sea board and northern frontier, with five floating batteries from the Mississippi river at the *Passes*, and below New Orleans, and five others for the defence of the harbor of New York, more than sixty three millions of that sum will be expended for *materials* and *work*, which the interior of the United states will afford.

Fourth—The most costly material required for the work will be *bar iron* for the *rail ways*, and sheeting for the sides and tops of the floating batteries; of this article not less than 500,000,000 lbs. will be needed. This quantity at 4 cents will amount to $20,000,000,—*twenty millions of dollars*.

Fifth—For supplying the whole of the iron, it is proposed to erect at convenient places, near the site of each one of the seven great railroads, *a foundry and rolling mill*, for the manufactory of the iron required, upon

the same principle that *armories* are established by the United States for supplying the army and navy, and the militia with cannon and small arms. By these works ample supplies of the best of iron may be obtained in season to complete the railroads and floating batteries, in the time here suggested.

We shall, in this way, lay open to the individual enterprize of the people of the United States rich mines of wealth, hitherto but little known; and we shall moreover relieve ourselves of the reproach to which we have for many years been subjected—the reproach of sending to Europe and expending there many millions of dollars for iron, whilst most of our States abound with inexhaustible supplies of this valuable metal, equal to any in Europe. * * * * * *

32. Your memorialist having at different times during the last seventeen years, submitted to the proper authorities of the War Department most of his views contained in the foregoing 30 sections, as will more fully appear from his official reports (which he prays may be called for and taken as a part of this his memorial) he has thus repeatedly appealed to the War Department; but he deeply regrets to say that his appeals have been wholly unavailing. He now respectfully calls on every member of the national Legislature who loves his country and her institutions, to sustain his efforts in preparing for her a system of defence worthy of their Fathers of the Revolution, worthy of the UNION and of the CONSTITUTION which we all stand pledged to support. Your memorialist did not enter the service of his country for the mere selfish enjoyment of the *pomp* and *ephemeral honors of the field of battle*, (though he would not shrink from a comparison of *his services in battle* with those of any other United States commander now living) his anticipated glory and great object have been to employ her means of defence, ample as they must ever be, so effectually as to convince her neighbours that *honesty is the best policy*, and that *defeat must attend their every act of invasion;* and thus to direct *the elements of war to the attainment of "peace on earth, and good will* towards men." With these impressions he deems it to be an act of common justice to himself, his wife, children and friends, that he should solicit the only relief to which a United States General officer, honored as he has long been with one of the highest commands in the army, and whose best efforts are ever due to his country's service can with propriety claim,—he claims to *be the author and inventor of the system of national defence* herein set forth and explained; he therefore prays Congress to confirm his claim by such *act* or *joint resolution* as in their wisdom shall seem just and right. And your memorialist as in duty bound will ever pray.

EDMUND PENDLETON GAINES.

Nashville, Tenn., Dec. 31st, 1839.

REPORT OF THE DIRECTORS OF THE THAMES TUNNEL COMPANY, TO THE GENERAL ASSEMBLY OF PROPRIETORS, *held at the London Tavern, on the 3rd day of March* 1840.

GENTLEMEN:—Your directors, in making their annual report, desire in the first instance, to refer to a passage in their last statement, which held out a prospect of the near termination of the hazardous portion of this important work.

Your directors then stated, "that they had the gratification to meet the proprietors after many years of anxiety and delay, with the most reasonable hope of having but one more annual meeting between the termination of

all the peculiar hazards and difficulties of the undertaking, and such an advance of the works as shall bring them near to the time when their anxious trust will be discharged by the completion of this most arduous enterprise."

Your directors have the satisfaction now to announce the entire realization of the prospect then held out, during the past year. From the first week after the last annual meeting to the present time, they have had the gratification to observe a steady increase in the rate of progress. For the first fifteen weeks after that meeting, the average weekly rate was under two feet per week, whilst, during the last few weeks the average progress has been increased to nine feet on an average weekly. With the increased rate of advance also, the average cost per foot has diminished, and has greatly tended to reduce the high average cost of the work per foot, whilst the excavation was carried on under the deepest part of the River.

Your directors, indeed, are of opinion, that could the plan of operation so elaborately detailed in two Reports, dated 18th of April and 15th of August, 1838, and which they referred to in detail in their last Report, have been adopted, both time and money would have been saved in the construction of the tunnel, an opinion which they have before expressed, and now repeat, in order to guard against the exaggerated notions of the cost of a roadway under a deep navigable river, compared with the ordinary mode of communication.

Their experience would now lead them to say, that whilst the steady and solid execution of this work proves the perfect practicability of Mr. Brunel's plans for constructing roadways under, instead of over navigable rivers, where circumstances render it necessary, no accurate judgment can be formed of the cost of such a work by that of the Thames tunnel, inasmuch as the Engineer has been constrained to follow a plan, the merit of which was solely (on the assumption of the impracticability of the work) that it risked the least portion of the public money, and for which object alone it was imposed upon the Engineer, when the money was advanced in aid of this undertaking.

The total progress during the year has been 245 feet, and the work is now within sixty feet of the wharf wall of Wapping.

Your directors are now negotiating for the purchase of the property on the Wapping shore, in order to commence the footway descent,—so soon as this shall be accomplished, your Directors propose to make arrangements to open and appropriate one Archway of the Tunnel for foot passengers, retaining the remaining one for the purpose of carrying on the Works until their final completion. They have the satisfaction to report, that according to the present plan, and provided the property could be advantageously obtained, the footway descent will be placed about fifty feet nearer the wharf than it was originally proposed, by which arrangement, this distance of tunnelling will be saved, as well as the earlier opening of the tunnel obtained.

Your directors continue to receive from the authorities of the corporation of London, every facility they can give towards the completion of the work.

Your directors now consider the work practically accomplished,—the local difficulties attending the construction of the tunnel are daily yielding to the progress of making; and they desire to congratulate the proprietors, and the public indeed, on the approaching termination of their labors, and of the great and important work entrusted to their care.

They believe it will long endure to do honor to the science and skill of the Engineer, and the spirit and liberality of the country. They are of

opinion that the tunnel fully deserves the description given of it by the Duke of Wellington, who, from the first to the last, has given it his countenance and support. His grace encouraged the continuance of this undertaking at a time when it was deemed impracticable, and when necessarily his authority and the interest he took in the work, was of the highest importance. In 1828, when the works were suspended, his grace described it as "a work important in a commercial as well as a military and political point of view." Your directors would add that not only do they consider this a just character of the undertaking, but that in point of economy and durability it will be found as a means of communication between the banks of the river, capable of being most favorably compared with any of the great metropolitan bridges.

Statements of the receipts and expenditure of the company, for the year which ended on the 31st of December, 1839, with a general balance sheet, have been prepared, and are now submitted by the directors for the information of the proprietors.

B. Hawes, *Chairman.*

Thames Tunnel Office, Walbrook buildings,
Walbrook, 3*d March*, 1840.

ON A SIMPLE MODE OF OBTAINING FROM A COMMON ARGAND OIL LAMP, A GREATLY INCREASED QUANTITY OF LIGHT; IN A LETTER FROM Sir. J. Herschel, Bart.

Gentlemen.—The following simple, easy, and unexpensive mode of greatly increasing the quantity of light yielded by a common argand burner has been used by me for some years, and is adapted to the lamp by which I write, to my greatly increased comfort. It consists in merely elevating the glass chimney so much above the usual level at which it stands in the burners in ordinary use that its *lower* edge shall clear the *upper* edge of the circular wick by a space equal to about the fourth part of the exterior diameter of the wick itself. This may be done to any lamp of the kind, at a cost of about sixpence, by merely adapting to the frame which supports the chimney four pretty stiff steel wires, bent in such a manner as to form four long upright hooks, in which the lower end of the chimney rests; or, still better, if the lamp be so originally constructed as to sustain the chimney at the required elavations without such addition, by thin laminæ of brass or iron, having their planes directed to the axis of the wick.

The proper elevation is best determined by trial; and as the limits within which it is confined are very narrow, it would be best secured by a screw motion applied to the socket on which the laminæ above mentioned are fixed, by which they and the chimney may be elevated or depressed at pleasure, without at the same time raising or lowering the wick. Approximately it may be done in an instant, and the experiment is not a little striking and instructive. Take a common argand lamp, and alternately raise and depress the chimney vertically from the level where it usually rests, to about as far above the wick, with a moderately quick but steady motion. It will be immediately perceived that a vast difference in the amount of light subsists in the different positions of the chimney, but that a very marked and sudden *maximum* occurs at, or near, the elevation designated in the commencement of this letter: so marked indeed as almost to have the effect of a flash if the motion be quick, or a sudden blaze as if the wick-screw had been raised a turn. The flame contracts somewhat in diameter, lengthens, ceases to give off smoke, and attains a dazzling intensity.

With this great increase of light there is certainly not a correspondingly increased consumption of oil. At least the servant who trims my lamp, reports that a lamp so fitted consumes very little if any more oil than one exactly similar on the common plan.

MR. SMEE'S NEW CHEMICO-MECHANICAL GALVANIC BATTERY.

The *London and Edinburgh Philosophical Magazine*, for this month contains a remarkably interesting paper by Alfred Smee, Esq., on the "Galvanic properties of the principal elementary bodies," with a description of a new battery invented by Mr. Smee, and called by him the "Chemico-Mechanical," which for all those *working* purposes on which the minds of men are now so intent, seems greatly to surpass every preceeding invention of the kind. The superior efficiency of this battery depends chiefly on two properties of metalic bodies first brought to light by the experimental investigations of Mr. Smee, (more fully at all events than they ever were before), namely, 1. That the galvanic energy of metallic surfaces, is in proportion to the number of points on such surfaces; and, 2. That platinum, which has long ranked at the head of the galvanic metals, may be precipitated in powder, on the surfaces of other and cheaper metals, so as to make them equal for galvanic purposes to platinum itself in its most comminuted state, such as spungy-platinum, which consists of almost an infinity of points. The battery is thus described by Mr. Smee:—

"The battery which I now propose is to be made of either copper plated with silver, silver, palladium, or platinum. The silver can be rolled to any thinness, and therefore is not expensive. Each piece of metal is to be placed in water, to which a little dillute sulphuric acid and nitro-muriate of platinum is to be added. A simple current is then to be formed by zinc placed in a porous tube with dilute acid; when after the lapse of a short time, the metal will be coated with a fine black powder of metallic platinum. The trouble of this operation is most trifling; only requiring a little time after the arrangement of the apparatus, which takes even less than the description. The cost I find to be about 6*d.* a plate of 4 inches each way, or 32 square inches of surface. This finely divided platinum does not adhere firmly to very smooth metals, but when they are rough is very lasting, and sticks so closely that it cannot be rubbed off. On this account, when either silver is employed, or copper coated with silver, the surface is to be made rough by brushing it over with a little strong nitric acid, which gives it instantly a frosted appearance, and this, after being washed, is ready for the platinizing process.

"With regard to the arrangement of the metal thus prepared great diversity exists; it may be arranged in the same way as an ordinary Wollaston's battery with advantage; a battery thus constructed possessing greater power than Profesor Daniell's battery: four cells, containing 48 square inches, in each cell, decomposed 7 cubic inches of mixed gas per five minutes, whilst four cells of Professor Daniell's, in which 65 square inches of copper were exposed in each cell, gave off only five cubic inches in the same time. However, in my battery thus arranged, the action dropped to five cubic inches in five minutes, but it resumed its power after the contact had been broken for a few seconds. This battery also possesses great heating powers, raising the temperature of a platinum or steel wire, one foot long, and of a thickness similar to that used for ordinary birdcages, to a heat that could not be borne by the finger.* Its magnetic power is not less astonishing,

* A small pot battery of six cells fairly fused into globules, two inches of iron wire, and the combustion of different metals was extremely brilliant, when the battery was in com-

three cells supporting the keeper of a magnet through forty-five, two cells through thirty-two, and one cell through twenty thicknesses of paper. An electro-magnetic engine was made to rotate with great velocity, the combustion of the mercury at the breaking of contact, being exceedingly brilliant.

"A battery of this construction should be in every laboratory to be used in most cases where a battery is wanted, and the slight labor attending its operation is scarce worth mentioning. I have used one for 48 hours consecutively without the slightest alteration either of the fluid, or in the arrangement of the metals, and the diminution attending its operation appeared to arise from deficiency of acid, for it *was instantly restored* by a little strong sulphuric acid in each cell. Where the battery is required to possess the same power for a long period, it might be advisable to separate the metals by a porous earthenware vessel, or what answers the purpose equally well, by a thick paper bag, the joinings of which must be effected by shell-lac dissolved in alcohol. By these means the sulphate of zinc is retained on the zinc side of the battery. The use of porous tubes, however, appears from observation, as far as my battery is concerned, *to be nearly superfluous*, at any rate in most cases; for I find that after a battery arranged as Wollaston's had been at work in the same fluid *for forty-eight hours*, it had no zinc deposited on the silver. It is worth remarking, that during the last 24 hours contact had not been broken for a single instant. Notwithstanding these experiments, however, it may be as well in an extensive battery to use porous plates.

"The battery may be arranged like the pot batteries, but I should greatly prefer the troughs, such as used for Wollaston's batteries, from the convenience of packing, and from a battery of the same surface requiring so small a space. A battery may be constructed to form a most powerful calorimotor. It may also be arranged as a circular disc battery. Or it may be made as a Cruickshank's each cell being divided or not by a flat porous diaphragm. Whatever arrangement is adopted, the closer the zinc is brought to the platinized metal, the greater will be the power.

"The generating fluid which is to be employed is water, with one-eighth of sulphuric acid by measure; and the zinc ought always to be amalgamated in the first instance, as that process will be found very economical from its stopping all local action, and the amalgamation will be found not to require repeating, because there is no fear of copper being thrown down on the zinc, which occasionally happens in the sulphate of copper batteries.

"The battery thus constructed is the cheapest and least troublesome in action that has ever been proposed, and from the smallness of its bulk will be found very valuable to electro-magneticians."

Mr. Smee adds:—

"This battery may remain in the acid for any length of time, and neither the amalgamated zinc nor platinized silver will undergo the slightest change, and the whole will be as silent as death. Let only communication be made, the liquid in each cell becomes troubled; it boils—it bubbles, and produces the effects which have been detailed."

ON THE CAOUTCHOUC MANUFACTURE, BY Andrew Ure, M. D., F. R. S., &c. &c.

This department of operative industry has, within a few years, acquired an importance equal to some of the older arts, and promises, ere long, to

bination with a Bachoffner's apparatus. A small piece of silver platinized (two inches each way) with a fold of zinc, was connected with a large temporary horseshoe magnet, when it supported upwards of three hundred weght.

rival even the ancient textile fabrics in the variety of its designs and applications. The manufacture of caoutchouc has, at present, three principal branches—1. The condensation of the crude lumps or shreds of caoutchouc, as imported from South America, India, &c., into compact homogeneous blocks, and the cutting of these blocks into cakes or sheets for the stationer, surgeon, shoemaker, &c. 2. The filature of either the Indian rubber bottles, or the artificial sheet caoutchouc, into tapes and threads of any requisite length and fineness, which, being clothed with silk, cotton, linen, or woollen yarns, form the basis of elastic tissues of every kind. 3. The conversion of the refuse cuttings and coarser qualities of caoutchouc into a viscid varnish, which, being applied between two surfaces of cloth, constitute the well known double fabrics, impervious to water and air.

I. The caoutchouc, as imported in skinny shreds, fibrous balls, twisted concretions, cheese like cakes, and irregular masses, is, more or less, impure, and sometimes fraudulently interstratified with earthy matter. It is cleansed by being cut into small pieces, and washed in warm water. It is now dried on iron trays, heated with steam, while being carefully stirred about to separate any remaining dirt, and is then passed through, between a pair of iron rolls, under a stream of water, whereby it gets a second washing, and becomes, at the same time, equalised, by the separate pieces being blended together. The shreds and cuttings thus laminated, if still foul or heterogeneous, are thrown back into a kind of hopper over the rolls, set one-sixteenth of an inch apart, and passed several times through between them. The above method of preparation is that practised by Messrs. Keene & Co., of Lambeth, in their excellent manufactory, under a patent granted in October, 1836, to Christopher Nickels, a partner in the firm.

In the great establishment of the Joint Stock Caoutchouc Company, at Tottenham, under the direction of Mr. Sievier, a gentleman distinguished no less by his genius and taste as a sculptor, than by his constructive talents, the preparatory rinsing and lamination are superseded by a process of washing practised in Mr. Nickels' second operation, commonly called the *grinding*, or, as it should more properly be styled, the *kneading*. The mill employed for agglutinating or incorporating the separate fragments and shreds of caoutchouc into a homogeneous elastic ball, is a cylindrical box or drum of cast iron, eight or nine inches in diameter, set on edge, and traversed in the line of its horizontal axis (also eight or nine inches long) by a shaft of wrought iron, furnished with three rows of projecting bars, or kneading arms, placed at angles of 120 deg. to each other. These act by rotation against five chisel-shaped teeth, which stand obliquely up from the front part of the bottom of the drum. The drum itself consists of two semi-cylinders; the under of which is made fast to a strong iron framing, and the upper is hinged to the under one behind, but bolted to it before, so as to form a cover or lid, which may be opened or laid back at pleasure, in order to examine the caoutchouc from time to time, and take it out when fully kneaded. In the centre of the lid a funnel is made fast, by which the cuttings and shreds of the Indian rubber are introduced, and a stream of water is made to trickle in, for washing away the foul matter often imbedded in it. The power required to turn the axis of one of these mills, as the drums or boxes are called, may be judged of from the fact, that if it be only two inches in diameter, it is readily twisted asunder, and requires to be three inches to withstand every strain produced by the fixed teeth holding the caoutchouc against the revolving arms. Five pounds constitute a charge of the material.

One of the most remarkable phenomena of the kneading operation, is the prodigious heat disengaged in the alternate condensation and expansion of the caoutchouc. Though the water be cold as it trickles in, it soon becomes boiling hot, and emits copious vapors. When no water is admitted, the temperature rises much higher, so that the elastic lump, though a bad conductor of heat, cannot be safely touched with the hand. As we shall presently find that caoutchouc suffers no considerable or permanent diminution of its volume by the greatest pressure which can be applied, we must ascribe the heat evolved in the kneading process to the violent intestine movements excited throughout all the particles of the elastic mass.

During the steaming, much muddy water runs off through apertures in the bottom of the drum. In the course of half an hour's trituration, the various pieces become aglutinated into a soft, elastic, ovoid ball, of a reddish brown color. This ball is now transferred into another similar iron drum, where it is exposed to the pricking and kneading action of three sets of chisel points, five in each set, that project from the revolving shaft at angles of 120 deg. to each other, and which encounter the resistance occasioned by five stationary chisel teeth, standing obliquely upwards from the bottom of the drum. Here the caoutchouc is kneaded dry along with a little quicklime. It soon gets very hot, discharges in steam through the punctures, the water and air which it had imbibed in the preceding washing operation, becomes, in consequence, more compact, and, in about an hour, assumes the dark brown colour of stationers' rubber. During all this time frequent explosions take place, from the expansion and sudden extrication of the imprisoned air and steam.

From the second set of drums the ball is transferred into a third set, whose revolving shaft, being furnished with both flat pressing bars, parallel, and sharp chisels, perpendicular to it, exercises the twofold operation of pricking and kneading the mass, so as to condense the caoutchouc into a homogeneous solid. Seven of these finished balls, weighing, as above stated, five pounds each, are then introduced into a much larger iron drum of similar construction, but of much greater strength, whose shaft is studded all round with a formidable array of blunt chisels. Here the separate balls become perfectly incorporated into one mass, free from honeycomb-cells or pores, and therefore fit for being squeezed into a rectangular or cylindrical form in a suitable cast iron mould, by the action of a screw press. When condensed to the utmost in this box, the lid is secured in its place by screw bolts, and the mould is set aside for several days. It is a curious fact that Mr. Sievier, has tried to give this moulding force, by the hydraulic press, without effect, as the cake of caoutchouc, after being so condensed, resiles much more considerably than after the compressing action of the screw. The cake form generally preferred for the recomposed, ground, or milled caoutchouc, is a rectangular mass, about 18 inches long, 9 inches broad, and 5 inches thick.

This is sliced into cakes for the stationer, and into sheets for making tapes and threads of caoutchouc, by an ingenious self-acting machine, in which a straight steel blade, with its edge slanting downwards, is made to vibrate most rapidly to and fro in a horizontal plane; while the cake of caoutchouc, clamped or embraced at each side between two strong iron bars, is slowly advanced against the blade by screw work, like that of the slide rest of a lathe. In cutting caoutchouc by knives of every form, it is essential that either the blade or the incision be constantly moistened with water; for otherwise the tool would immediately stick fast. Since the above straight vibrating knife slants obliquely downwards, the sheet which it cuts off

spontaneously turns up over the blade in proportion as it is detached from the bottom mass of the cake. The thicker slices are afterwards cut by hand, with a wetted knife, into small parallelopipeds, for the stationer, the sections being guided rectangularly by saw lines in a wooden frame. The wholesele price of these is now reduced to 2s. per pound. Slices may be cut off to almost any desired degree of thinness, by means of an adjusting screw mechanism, that acts against a board which supports the bottom of the cake, and raises it by an alliquot part of an inch, the cutting blade being caused to vibrate always in the same horizontal plane. These thin slices constitute what is called sheet caoutchouc, and they serve perfectly for making tubes for pneumatic apparatus, and sheaths of every kind; since, if their two edges be cut obliquely with clean scissors, they may be made to coalesce, by great pressure, so intimately, that the line of junction cannot be discovered either by the eye, or by inflation of a bag or tube thus formed.

The mode of recomposing the cuttings, shreds, and coarse lumps of caoutchouc into a homogeneous elastic cake, specified by Mr. Nickels, for his patent, sealed October 24, 1836, is not essentially different from that above described. The cylinders of his mill are more capacious, are open at the sides like a cage, and do not require the washing apparatus, as the caoutchouc has been cleansed by previous lamination and rinsing. He completes the kneading operation, in this open cylinder, within the space of about two hours, and afterwards squeezes the large ball so formed into the cheese form, in a mould subjected to the action of a hydraulic press. As he succeeds perfectly in making compact cakes in this way, his caoutchouc must differ somewhat in his physical constitution from that recomposed by Mr. Sievier's process. He uses a press of the power of 70 tons; such pressure, however, must not be applied suddenly, but progressively, at intervals of two or three minutes between each stroke; and when the pressing is complete, he suffers the caoutchouc to remain under pressure till it is cold, when he thrusts it out of the mould entirely, or, placing his mould in the slide-rest mechanism, he gradually raises the caoutchouc out of it, while the vibrating knife cuts it into slices in the manner already described. The elegant machine by which these sheets are now so easily and accurately sliced, was, I believe, originally contrived and constructed by Mr. Beale, engineer, Church-lane, Whitechapel.

II. *Filature of Caoutchouc for making Elastic Fabrics.*—Messrs. Rattier and Guibal mounted in their factory at St. Denys, so long ago as the year 1826 or 1827. a machine for cutting a disc of caoutchouc into a continuous fillet spirally, from its circumference towards its centre. This flat disc was made by pressing the bottom part of a bottle of Indian rubber in an iron mould. I have described this machine under the article ELASTIC BANDS, in my Direction of Arts, &c. A machine on the same principle was made the subject of a patent by Mr. Joshua Proctor, Westhead, of Manchester, in Feb. 16, 1836; and, being constructed with the well-known precision of Manchester workmanship, it has been found to act perfectly well in cutting a disc of caoutchouc, from the circumference towards the centre spirally, into one continuous length of tape. For the service of this machine, the bottom of a bottle of Indian rubber of good quality being selected, is cut off and flattened by heat and pressure into a nearly round cake of uniform thickness. This cake is made fast at its centre by a screw nut and washer to the end of a horizontal shaft, which may be made to revolve with any desired velocity by means of appropriate pulleys and bands, at the same time that the edge of the disc of caoutchouc is

acted on by a circular knife of cast steel, made to revolve 3000 times per minute, in a plane at right angles to that of the disc, and to advance upon its axis progressively, so as to pare off a continuous uniform tape or fillet from the circumference of the cake. During this cutting operation, the knife and caoutchouc are kept constantly moist with a slender stream of water. A succession of threads of any desired fineness are afterwards cut out of this fillet, by drawing it in a moist state through a guide slit, against the sharp edge of a revolting steel disc. This operation is dexteriously performed by the hands of young girls. MM. Rattier and Guibal employed, at the above mentioned period, a mechanism consisting of a series of circular steel knives, fixed parallel to each other at minute distances, regulated by interposed washers upon a revolving shaft; which series of knives acted against another similar series, placed upon a parallel adjoining shaft, with the effect of cutting the tape throughout its length into eight or more threads at once. An improved modification of that apparatus is described and figured in the specification of Mr. Nickel's patent of October, 1836. He employs it for cutting into threads the tapes made from the recomposed caoutchouc.

The body of the bottle of Indian rubber, and in general any hollow cylinder of caoutchouc, is cut into tapes by being first forced upon a mandril of soft wood of such dimensions as to keep it equally distended. This mandril is then secured to the shaft of a lathe, which has one end formed into a fine-threaded screw, that works into a fixed nut, so as to traverse from right to left by its rotation. A circular disc of steel, kept moist, revolves upon a shaft parallel to the preceding, at such a distance from it as to cut through the caoutchouc, so that, by the traverse movement of the mandril shaft, the hollow cylinder is cut spirally into the continuous fillet of a breadth equal to the thickness of the side of the cylinder. Mr. Nickels has described two methods of forming hollow cylinders of recomposed caoutchouc for the purpose of being cut into fillets by such a machine.

It is probable that the threads formed from the best Indian rubber bottles, as imported from Para, are considerably stronger than those made from recomposed caoutchouc, and therefore much better adapted for making Mr. Sievier's beautiful patent elastic cordage. When, however, the kneading operation has been skilfully performed, I find that the threads of the *ground* caoutchouc, as it is incorrectly called by the workmen, answers well for the every ordinary purpose of elastic fabrics, and are of course, greatly more economical, from the much lower price of the raw material.

Threads of caoutchouc are readily pierced by paring the broken ends obliquely with scissors, and then pressing them together with clean fingers, taking care to admit no grease or moisture within the junction line. These threads must be deprived of their elasticity before they can be made subservient to any torsile or textile manufacture. Each thread is *inelasticated* individually in the act of reeling, by the tender boy or girl possessing it between his moist thumb and finger, so as to stretch it at least eight times its natural length, while it is drawn rapidly through between them by the rotation of the power-driven reel. This extension is accompanied with condensation of the caoutchouc, as shown in my former paper (see the Journal for last month,) and with very considerable disengagement of heat, as pointed out in Nicholsons Journal, upwards of 30 years ago, by Mr. Gough, the blind philosopher of Kendal. I attempted to stretch the thread, in the act of reeling, but found the sensation of heat too painful for my unseasoned fingers. The reels, after being completely filled

with the the thread, are laid aside for some days, more or fewer, according to the quality of caoutchouc, the recomposed requiring a longer period than the bottle material. While thus rendered inelastic, it is wound off upon bobbins of various sizes, adapted to various sizes of brading, or other machines, where it is to be clothed with cotton or other yarn.

The thread of the Joint Stock Caoutchouc Company is numbered from 1 to 8. No. 1 is the finest, and has about 5000 yards in a pound weight; No. 4 has 2000 in a pound weight; and No. 8, 700, being a very powerful thread. The finest is used for the finer elastic tissues, as for ladies' silver and gold elastic bracelets and bands. The ropes made by Mr. Sievier with the strongest of the above threads, clothed with hemp, and worked in his gigantic braiding machine, possess, after they are re-elasticated by heat, an extraordinary strength and elasticity, and, from the nearly rectilinear direction of all the strands, can stand, it is said, double the strain of the best patent cordage of all diameter.

In treating of the manufacture of elastic fabrics, I have great pleasure in adverting to the ribbon looms at Holloway, which display to great advantage the mechanical genius of the patentee, Mr. Sievier. Their productive powers may be inferred from the following statement:—5000 yards of one inch braces are woven weekly in one 18 ribbon loom, whereby the female operative, who has nothing to do but to watch its automatic movements, earns 10s. a week; 3000 yards of two inch braces are woven upon a similar loom in the same time. But one of Mr. Sievier's most curious patent inventions, is that of producing, by the shrinking of the caoutchouc threads in the foundation or warp of the stuff, the appearance of raised figures, closely resembling coach lace, in the weft. Thus, by a simple physical operation, there is produced, at an expense of one penny, an effect which could not be effected by mechanical means for less than one shilling.

III. *Of the Water-proof Double Fabrics.*—The parings, the waste of the kneading operations above described, and the coarsest qualities of imported caoutchouc, such as the inelastic lumps from Para, are worked up into varnish, wherewith two surfaces of cloth are cemented, so as to form a compound fabric, impervious to air and water. The caoutchouc is dissolved either in petroleum (coal tar) naphtha, or oil of turpentine, by being triturated with either of the solvents in a close cast iron pot, with a stirring apparatus, moved by mechanical power. The heat generated during the attrition of the caoutchouc, is sufficient to favor the solution, without the application of fuel in any way. These triturating pots have been called pug mills by the workmen, because they are furnished with obliquely pressing and revolving arms, but in other respects they differ in construction. They are four feet in diameter and depth, receive 13 cwt. at a time, have a vertical revolving shaft of wrought iron four inches in diameter, and make one turn in a second. Three days are required to complete the solution of one charge of the varnish materials. The proportion of the solvent oils varies with the object in view, being always much less in weight than the caoutchouc.

When the varnish is to be applied to very nice purposes, as bookbinding, &c., it must be rubbed into a homogenous smooth paste, by putting it in a hopper, and letting it fall between a couple of parallel iron rolls, set almost in contact.

The wooden framework of the gallery in which the waterproof cloth is manufactured, should be at least 50 yards long, to give ample room for extending, airing, and drying the pieces; it should be two yards wide, and

not less than five high. It is formed of upright standards of wood, bound with three or four horizontal rails at the sides and the ends. At the end of the galley, where the varnish is applied, the web which is to be smeared must be wound upon a beam, resembling in size and situation the cloth beam of the weaver's loom. The piece is thence drawn up and stretched in a horizontal direction over a bar, like the breast beam of a loom, whence it is extended in a somewhat slanting direction downwards, and passed over the edge of a horizontal bar. Above this bar, and parallel to it, a steel-armed edge of wood is adjusted, so closely as to leave but a narrow slit for the passage of the varnish and the cloth. This horizontal slit may be widened or narrowed at pleasure by thumb screws, which lower or raise the movable upper board. The caoutchouc paste being plastered thickly with a long spatula of wood upon the down-sloped part of the web, which lies between the present beam and the above described slit; the cloth is then drawn through the slit by means of cords in a horizontal direction along the lowest rails of the galley, whereby it gets uniformly besmeared. As soon as the whole web, consisting of about 40 yards, is thus coated with the viscid varnish, it is extended horizontally upon rollers, in the upper part of the gallery, and left for a day or two to dry. A second and third coat are then applied in succession. Two such webs, or pieces, are next cemented face to face, by passing them, at the instant of their being brought into contact, through between a pair of wooden rollers, care being taken by the operator to prevent the formation of any creases, or twisting of the twofold web. The under of the two pieces being intended for the lining, should be a couple of inches broader than the upper one, to ensure the uniform covering of the latter, which is destined to form the outside of the garment. The double cloth is finally suspended in a well ventilated stove room, till it becomes dry, and nearly free from smell. The parings cut from the broader edges of the under piece, are reserved for cementing the seams of cloaks and other articles of dress. The tape-like shreds of the double cloth are in great request among gardeners, for nailing up the twigs of wall shrubs.

Mr. Walton, of Sowerby-bridge, has recently substituted sheet Indian rubber for leather, in the construction of the fillet cards for the cotton and tow manufactures. The superior elasticity of this article is said to prove advantageous in several respects.—*Jour. Arts & Science.*

TO THE HONORABLE THE MAYOR, ALDERMEN AND COMMONALTY OF THE CITY OF NEW YORK, IN COMMON COUNCIL CONVENED.—*The petition of the New York and Harlem railroad company, respectfully showeth,*

That your petitioners were incorporated by an Act of the legislature of the State of New York, passed April 25th, 1831, and authorised to construct a railroad, with a double track, to the Harlem river, with a branch to the Hudson river, between 124th and 129th streets. That your petitioners under authority of the aforesaid act of incorporation, and of the subsequent acts of the legislature amending and extending the same, have constructed a railroad, with a double track, from the city hall in the city of New York to the Harlem river, and have now employed thereon, for the transportation of persons and property, six locomotive engines, a large number of cars, and one hundred and forty horses. That at the period when your petitioners commenced the construction of their said road, no railroad of any magnitude had been constructed within the United States, and the art of their construction was in its infancy here, and but little developud at that time comparatively in England. That the natural surface and formation of the land over which the railroad of your petitioners was to run, presented ob-

stacles to the enterprise, of a number and magnitude not to be met with in any railroad of the same length. That in overcoming these obstacles, and in contributing, by the experience gained in the construction of this work, to the advancement of that art which has since been of such signal advantage to the country, and in placing said road in full and complete operation, your petitioners have expended upwards of eleven hundred thousand dollars. That no divedend has ever been made upon the capital stock of your petitioners, and no return has yet been received by their stockholders upon this investment of their property. That when the construction of the railroad of your petitioners was projected, it was contemplated by its originators that as early as it could be completed, a road would be constructed, from the Harlem river northwardly, leading to Albany, and intersecting with the road of your petitioners; and thus giving to their road the advantage of an extended track and a large transportation of the productions of the country.

And your petitioners further show, that accordingly the legislature of the State of New York, by an act passed April 17th 1832, incorporated a company by the name and title of the New York and Albany Railroad Company, with authority to construct such a railroad: That under the expectation that the said last mentioned road would be codstructed by said company, and the original project upon which the enterprise of your petitioners was founded, be thus extended and carried out. Your petitioners persevered in the construction of their works nnder the most constant succession of the most perplexing and discouraging circumstances, until they had the high gratification of completing their road to Harlem, and thus performing their engagements with the people: That the New York and Albany Railroad Company thus incorporated to construct the important work to which your petitioners had ever looked for a share of the bnsiness which was to furnish a just remuneration for their capital invested, after ineffectual efforts to fill up their capital stock, and various extensions of their charter by the Legislature, givign them additional time to fill up their stock and to construct their railroad, became convinced by the experience of seven years unsuccessful labor, that they could not command the necessary means to construct said work, or accomplish the great object for which they were incorporated: That from the early part of the year 1838, it was averred by the inhabitants of the counties of Dutchess and Putnam, that if the railroad could be constructed to the northern boundary of the county of Westchester, a distance of about forty-two miles from the termination of the present road of your petitioners, the citizens of said counties would supply the means to construct said road through the said counties of Putnam and Dutchess, a distance of about seventy-three miles, to connect with the Albany and West Stockbridge road. That your petitioners fully believe that such undertaking will be performed by the inhabitants of Putnam and Dutchess counties, and the expectation of their efficient co-operation, induced the New York and Albany railroad company to apply to the legislature for the aid of the State, at the session of 1839, for the purpose of enabling them to construct their said road through the county of Westchester, and thus connect its continuation to the liberal and enterprising people of the counties aforesaid: And your petitioners further show, that apppre hending from the total failure of the New York and Albany railroad company to make but little progress in the construction of their work, for a period of upwards of seven years, that the said company would never be able to complete such work, and viewing its early construction as of vital importance to the commerce, convenience, and interest of the city of New York as well as an object of immediate concern to your petitioners—your petitioners were induced to apply to the legislature of the State of New York, at

the session of 1840, for leave to extend their railroad to the northern boundary of Westchester county, and thus bring this great link in the chain of communication, between the commercial metropolis and the mighty west, within the reach of those who stand ready to complete it:

That before making any application to the legislature for the purpose aforesaid, your petitioners caused a draft to be made of an act authorising and empowering them to construct a railroad with a single or double track, through the county of Westchester, commencing at the Harlem river and extending with one line of road from thence northwardly to an intersection with the New York and Albany railroad company's line of road at such point as might be mutually agreed upon between the two companies, with authority to construct a bridge across the Harlem river to connect the same with the present road of your petitioners, and informed the said New York and Albany railroad company of such design of your petitioners, and submitted to them the draft of the law which your petitioners had so prepared for that purpose. That the said New York and Albany railroad company fully approved of the application so proposed to be made by your petitioners, and of the law as drafted by them; but wished some further stipulations for their benefit, coupled with such assent to reimburse them for all expenses therefore incurred by them in Westchester county, within which the road theretofore proposed to be made by them was to be taken and constructed by your petitioners. And your petitioners further show, that they assented to the said proposition of the New York and Albany railroad company, and thereupon an agreement in writing was duly made and entered into by and between the said companies in relation to said laws, as follows, that is to say,—

New York, Feb. 28, 1840.

The undersigned hereby agree to the amendments as expressed in the subjoined copy of an act amending the New York and Harlem railroad company, about to be submitted to the legislature.

We also agree and mutually bind ourselves to the following stipulations, viz: the New York and Harlem railroad crmpany agree to pay the New York and Albany railroad company all expenses hitherto paid out and incurred by them in Westchester county; payment to be made in the stock of the New York and Harlem railroad company, or in bonds of the company, at three years from the passage of the act in question, on the assumption of the rights that may be granted and the commencement of the work.

(Signed) CHAS. HENRY HALL,
President of the New York and Albany R. R. Co.
GOUVERNEUR MORRIS,
V. P. N. Y. & Albany R. R. Co.

FRANCIS BARRETTO,
JONATHAN A. TABER,
JONATHAN AKIN,
ALPHEUS SHERMAN,
JOHN HARRIS,
} *Directors of the Company.*

I hereby concur in the above arrangement.

(Signed) SAMUEL R. BROOKS,
President of the N. Y. & Harlem R. R. Co.

That at a meeting of the board of directors of your petitioners, the said contract entered into by the president of your petitioners on their part, with the New York and Albany railroad company was duly confirmed.

And your petitioners further shew, that in pursuance of said agreement, the law so drafted and assented to by the New York and Albany railroad company was presented to the legislature, and was duly enacted by them on

the 7th of May, 1840.—That a copy of said act is hereunto annexed, marked paper A. That in and by the said act the legislature fully ratified and confirmed the contract made between the said New York and Albany railroad company and your petitioners, and vested in them all the powers contained in the several acts authorising the construction of the New York and Albany railroad; gave to your petitioners the exclusive right of constructing a railroad northwardly through Westchester county.

And your petitioners further show, that under and by virtue of the said last mentioned act of the legislature, your petitioners are about proceeding to locate their railroad to the northwardly boundary of Westchester county, and intend to construct such railroad as soon as the necessary means can be obtained for that purpose. That your petitioners conceive that great and important advantages will flow to the city of New York from the construction of the said railroad, and that the benefits will be more immediate from such being accomplished by your petitioners than would accrue were it to be performed by another Company.

That from the road of your petitions being in full operation, with sufficient engines, cars, and horses, for a more extended action, as soon as one mile of the new road should be constructed, your petitioners could extend the trips of their cars to the point of such completion, while a new Company would be obliged to complete a very considerable part of the road before they could afford to make the necessary outlay for engines and cars, and commence operations upon it.

And your petitioners further show, that the connection of the City of New York with the City of Albany, by means of a railroad, is a subject deeply interesting, not only to the inhabitants of this city, but to the whole Northern and Western country. That during one quarter of the year the Hudson river is closed with ice; and at the most inclement and inactive season communication between the inteaior and the city is absolutely cut off, or accomplished with so much labor, toil, and danger, as to deter vast numbers from making the attempt. The supplies of the provisions, as well as the means of commercial intercourse, are either suspended or procured at great additional expense. The line of railroad between Albany and Buffalo is now more than two-thirds completed, and the residue in progress of construction under the flattering prospect of presenting a continous line of railroad between those two cities as early as the year 1841. That our enterprising and vigilant neighbors of the city of Boston, are rapidly progressing with their Great Western railroad, designed to reach the capitol of our State; and have recently taken the capital stock of the Albany and West Stockbridge railroad, and engaged in the construction of that work to ccmplete their line of direct communication with the great lakes. The city of Albany, with a zealous regard for the interests of its inhabitants, has freely lent its credit to the extent of six hundred thousand dollars to that enterprise, which is designed to make that city and Boston the great market for disposing of the manufacture of the east, and procuring the supplies from the west. While this enterprise and zeal have been exhibited all around us, giving artificial advantages to places not able to compete with us by the gifts of nature, the inhabitants of this city, and the publicly chosen and constituted guardians of the interests and welfare, have not as yet aided in the construction of this important link in the great chain of intercommunication, or contributed to ensure a free access for all purposes of commerce, business and pleasure to the vast regions with which we trade. That during the long continued period of commercial embarrassment and adversity through which we have been passing, our enterprising and liberal-minded citizens have been unabled to withdraw from their private

business the means of erecting a great public work ; and under these circumstances your petitioners are compelled to seek a loan of the public credit, upon the most ample security, and for the most laudible objects and extended benefits. That by a loan of the credit of the city to the extent of three hundred thousand dollars your petitioners will be enabled immediately to undertake and forthwith construct their road through the County of Westchester ; and thus, with the aid of the inhabitants of Putnam and Dutchess, soon complete the whole line to Albany. That as a security for such loan, your petitioners have to offer a mortgage constituting the first lien upon their railroad now completed to Harlem, and which, in itself, cost your petitioners the sum of upwards of nine hundred thousand dollars exclusive of the appurtenances to the road, which cost between two and three hundred thousand dollars. That as a public return for this public favor, your petitioners will make, free, rapid and easy access to the rich interior of some of our most populous and wealthy counties, and open the markets of this city to the bountiful and cheap supplies of their productions at all seasons of the year. Your petitioners therefore pray that your honorable body will be pleased to pass an ordinance authorising the issue of the bonds of this city to your petitioners, to the extent of three hundred thousand dollars, the bonds to be payable in twenty years, bearing interest at five per cent., payable semi-annually, upon your petitioners executing a mortgage to the Corporation upon their railroad now constructed, and constituting the first lien or encumbrance thereon ; the whole amount of which bonds, or of the proceeds and avails thereof, to be applied solely and exclusively, under the direction of the comptroller, or such officer as your honorable body may be pleased to designate, to the construction of such railroad within the limits of the county of Westchester ; or that your honorable body would grant to your petitioners such other or further aid in the premises as in your judgment may best promote the interests of the people.

And your petitioners will ever pray, &c.

[L. S.] SAMUEL R. BROOKS, *President.*

BENJAMIN COX, *Secretary.* *New York, July* 11*th*, 1840.

The Commercial List of Saturday last, contains the following :—

Locomotive Engines.—Amid the general gloom and stagnation in business, particularly among the manufacturers, it is gratifying to be able to state that such is the acknowledged superiority of the Locomotive Engines manufactured by our ingenious fellow citizen, WM. NORRIS, that his establishment continues in full operation ; upwards of 275 hands being employed in it at the present time. Numerous orders have been received by him from the *Old World*, and more are soon expected. Among the orders already executed for Europe, we notice the following ; eleven engines have been constructed and received in England for the Birmingham and Gloucester railway, and an order from the Directors, for two additional machines, has just been received by the Great Western.

Five engines have been ordered and despatched to AUSTRIA and a sixth is to be shipped thence in a few days. One locomotive has been completed for a railway in Germany, and seven more have been contracted for. In addition to the above establishment, we have the extensive establishments of Messrs. Baldwin, Vail & Hufty, and Eastwick & Harrison in this city, whose machines are of the first order.

In the number and variety and extent of her manufacturing establishments, Philadelphia stands proudly conspicuous among her sister cities, and with a return of better times, the number will be materially increased.

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 3, Vol. V. New Series.	AUGUST 1, 1840.	Whole No. 363. Vol. XI.

NOTICES OF ENGLISH PATENTS.

To Miles Bery, for the process now known as the Daguerreotype, being a communication from a foreigner residing abroad—14th August, 1839.

This is a most remarkable case of a patent, and calculated somewhat to dim the lustre of M. Dagueni's fame. It is well known that the French government gave to the inventor of this process and to his partner, a liberal annuity, and much noise was made about the liberality of the French nation—rewarding her artists and giving the world the result of their labors. When the arrangement with the French government was concluded, M. Daguenis communicated his prowess to M. Bery, patent agent, and received his letters patent a few days previous to the promulgation in France. Then persons who had paid the exorbitant price demanded for the apparatus, countersigned by Mr. Dauguenis himself, were prevented from using the same, until they had taken out and paid for a licence. In all this, perhaps, there is nothing illegal, but there is certainly something very mean, after all the parade of "liberality," "glory," &c. So at least thought certain gentlemen, artists and amateurs, who, doubting the fact that M. Dagueni had authorised this proceeding, addressed him a letter, asking for information. They received a very polite letter, acknowledging the fact, and stating that Mr. D. had given the secret to the French nation, and not to the world!

To William Vickers, for a mode of obtaining tractive power, from carriage wheels, under certain circumstances.—6th March, 1839.

The invention is a mode of coupleing the driving and running weeels of a locomotive by a an endless band passing over pullies on the ends of the axles.

Z. Mores Poole, for improvements in constructing and applying boxes to wheels—from a foreigner, residing abroad.—29th Feb. 1839.

Iron boxes are to be screwed into the wooden naves.

To Thomas McGaman, manufacturer of paper, from a material not hitherto employed.—26th August, 1839.

This improvement is the use of the hop vine. The patentee is in error in stating that this is a material never before used in making paper.—Many years ago a namesake of our own, in Germany, published a book on paper making, to which was affixed specimens of paper from every imaginable source down to potatoes; straw, and various other common stalks were among the number, and we think the hop plant also. It appears too, that the experiment, was tried elsewhere.

To Mores Poole for obtaining rotary motion—being a communication from a foreigner residing abroad.

This patentee possessed with a firm conviction of the great loss of power in the crank, produces the following contrivance to supersede the use of the crank in all kinds of machinery. Around a cylinder on the shaft to be moved, is cut an oblique groove, returning into itself; a pin in the piston rod presses against the side of this groove, and causes the cylinder to revolve. Besides not being good for any thing (at least as a mode of communicating power,) this contrivance is not new.

To Antonio Morillon, for improvement in machinery for propelling ships, boats, and other vessels on water, designed to supersede the use of paddle wheels.

The improvement consists in the use of expanding paddles, after the manner of a duck's foot. This and all similar attempts to "supersede the paddle wheel," are founded on an erroneous idea of the great loss of power in the ordinary paddle wheel. The greater complication of parts, and in general, the enormous increase of friction, render such invention impracticable.

To the Editors of the Railroad Journal and Mechanics' Magazine.

Engineers' Camp, Harrisburg and Pittsburg
Railroad Survey, July 13th. 1840.

Gentlemen:—You will please to insert the following remarks, intended as a reply to Mr. B. Aycrigg's communication on the *Theory of the Crank*, as far as the position is concerned, which has been assumed by me in this matter, and which as yet stands unimpaired.

Mr. Aycrigg says on page 325 of the same number, that if power was lost, by changing a straight into a rotary motion, *we may gain by reversing the action, and converting the circular into a rectilinear motion, and consequently construct a perpetual motion.*

To this I reply, that if we could change a rotary motion into a straight motion, *without applying a straigh motion*, we would accumulate power.

But since this is impracticable, and since a rotary motion, produced by a previous straight motion, causes a *loss* of as much useful power, as the change from a rotary motion into a straight motion will cause a *gain* of useful power, the *loss* will balance the *gain* during the action of the machine

and there can therefore be no accumulation of power, hence no chance of a *perpetual motion.*

The same gentleman continues on the same page:

"In the first case, where the power acts in parallel lines, we have precisely the condition of gravity, causing the descent of a heavy body on a curved inclined plane. Here it has been generally conceded that no power is lost."

In answer I beg leave to remark, that the question of the motion on a *curved or inclined plane,* and the *crank* or *rotary* motion, rest upon the same principle, and they must either stand or fall together. The principle I contend for, is: that when a body has received an impulse of motion, this impulse will continue to operate in the same direction, unless the course of motion is checked, and if then, the force of the impulse be not allowed to develope itself freely, the *momentum of the impulse will loose some power.*

Though the change of motion, and consequent reduction of power, may be very small indeed at a time, yet a continuous succession of such small losses will produce something very material. Mr. Aycrigg then offers *a more conclusive mode of investigation,* and says:

"Take the first case, where the power acts parallel,

$$P : f :: R : \sin c$$
$$V : v :: \sin c : R$$

P.V = f.v. But P.V is the expense of power, and f.v the effect, therefore we see, that there is no less of power."

To this the following is offered, using the same signs and letters:

The first proposition,

$$P : f :: R : \sin c$$

I admit as correct. But I object to the second, and confess to be at a loss to understand how it could be admitted by the mathematical talent of the distinguished writer.

Without referring to a diagram, it will be agreed on, that the respective velocities of the *prime mover,* and of the *crank-pin,* are as the *spaces* through which they have actually moved.

Now if the angle, included by the direction of the prime mover and the crank, is denoted by *c,*

The measure of the space, through which the prime mover has actually moved, will be equal to the *sine verse* of the angle *c.*

And the space through which the crank-pin has moved at the same time, must be represented by the *arc,* belonging to the angle *c.*

Therefore the following proportion will be admitted as correct:

$$V : v :: \text{Sine verse } c : \text{arc } c$$

Mr. Aycrigg's proportion is,

$$V : v :: \text{Sines } c : \text{Radius}$$

and if correct, the following proportion should also be right:

$$\text{Sine verse } c : \text{arc } c :: \text{Sine } c : R$$

But this is evidently incorrect, as the Sine verse can bear no *definite* relation to an arc or the circumference of a circle.

The error will become more apparent, by supposing the angle c equal to 90 degrees. Then the sine verse will = R and the sine = R

Hence R : arc 90° : : R : R

Therefore : the arc of the quadrant = Radius

This being a *reductio ad absurdum* the above positive demonstration must be rejected.

Let me conclude with the remark, that although most investigations, presented to the scrutiny of the human mind, are more or less to be conducted on the principle of *compromising contending views*, such sort of reasoning should never be allowed to enter the field of mathematical researches. All arguments on this science should be directly to the point, and be based upon indisputable axioms, and when a new proposition is offered and opposed, let the error in the reasoning be clearly pointed out.

Yours, very respectfully,

John A. Roebling, C. E.

For the American Railroad Journal and Mechanics' Magazine.

The rise and progress of this nation, with the incalculable benefits it has conferred on the civilized world, and which it bids fair to confer till the end of time, justly excites proud and patriotic feeling in the heart of every American. If we judge from the signs of the times and the history of the past, we may conclude that this nation is destined by providence to take the lead in the great struggle for man's moral and mental melioration, and the final enlightenment of the whole world. But man in this and every age, is imperfect, and as we look back through the long line of his history, we find that all his best endeavors and loftiest attainments, have been stained by error, and defaced by evil. How often do we find religion accompanied by zeal without knowledge, degenerating into intoleracne. Science without study or thought becoming sciolism, and liberty without moderation, due fore thought and check, becoming licentiousness! Critics in the old world and in the new, have long complained of the feebleness of American literature, and have at length come to the conclusion, that as a people we are too active, that our efforts spread over a large surface, becoming hurried rather than strong, have rendered us superficial;—that we are too much absorbed in the cares and business of life to produce great scholars, and too much enfeebled by the "auri sacra fames" to find leisure for the pursuits of poetry and art. Without stopping to remark farther upon this head, we will proceed to trace the effects of this superficiality, to which, as a nation, we must plead guilty, upon mechanism, and the mechanic arts. We do not remember to have heard this subject spoken of either by scientific or literary men, and as page upon page have been written upon the effects of superficiality upon literature and philosophy, and nothing upon its effects on the mechanic arts, we are led to conclude that the public either think that sound ac-

quirements in this department of knowledge are of little importance, or that a sufficient amount of study is already invested in it. We now assert that *in the various trades and arts in which American industry exerts itself, there is not sufficient study upon correct theory, and not sufficient practice in the manipulations.* Let not the objector meet us here by telling us that our country is the "country of improvements"—that no portion of our planet was ever so rapidly transformed from wild forests to clutivated fields, —that in no part of the world has man so nearly realized the lover's wish in Shakspeare, of annihilating time and space. True, we are proud to say that, if we except the art of printing, the most important invention made by man, and which, next to printing, is the most important element in the world's civilization, was the product of American mind; we are proud that our country, although numbering two millions of square miles in extent, is so intersected by canals and railroads, that it forms one vast *neighbourhood* of enterprising and improving men. We have made a good beginning, but now that our resources are multiplying, our nationality is forming, and we are rapidly acquiring strength as a people, we should look beyond the present, and think and act for posterity. Our efforts and enterprize have been hitherto directed to *immediate* profit and utility. We have endeavored to advance and accomplish as cheaply and expeditiously as possible. Our railroads, bridges, canals, public edifices, and machinery, have been constructed "for the nonce," as it were. We are not blaming our countrymen in these remarks, but now that the beginning has been made, and the gristle of our young republic is hardening into bone, and its thews and sinews are becoming strong and matured, let us do worthy of our resources, our native talent, our destiny. 1. Take for example the art of Architecture. Consider the vast amount expended in the construction of buildidgs, public and private; and how few there are in the United States, which will last for centuries, and become hallowed by glorious associations, and rendered sacred as "chronicles of Eld." Our own city contains few edifices which are at all worthy of American enterprise,—and in others the number is still smaller. Indications we do see however, that more attention is beginning to be paid to architecture, and we may anticipate triumphs worthy of old Greece or Rome. 2. In our canals and railroads the same fault is evident: in ths first there are too many locks—in the second, too many curves; we build too cheaply. The Erie canal is an evidence. Circumstances rendered it necessry to construct it as narrow and as cheaply as possible—we doubt not that good policy was at helm; but it would not be politic or prudent at the present day to construct another in the same manner. Our rail cars ascend too great inclinations; many are the contrivances for obtainning a sufficient amount of friction in order to ascend a *steep hill*, the contrivers forgeting that for every 18 feet ascent* per mile, ~~[illegible]~~ one third more power is required than would be necessary on a level; and thus in passing over millions of miles (as some of our rail cars do in a year) much in the end is lost by "*cheap railroads.*" 3. The engineer's art has been sadly neglect-

* nonsense, the Engineers locating the road know this well enough, but know also, that double the amount of

ed and perverted. The steam engine, the mightiest and most wonderful machine ever made by man, the most cunning in its construction, and which of all others requires deep study and long and skilful practice in order to ensure succcss in its operation, has become a play-thing in the hands of smatterers and novices. A machine which brings with it intercourse, civilization and good feeling, between the people of different nations, which makes them neighbors assimilates their interests, character and feelings, wears off national prejudice and national jealousy—which should prove a blessing to man, has in our own country been the cause of "mourning, lamentation, and wo." Say not that the immense amount of good which it has already accomplished, more than balances the horrid and sudden death of thousands. Can you sooth the widow in telling her of the immense flood of wealth which the steam engine is pouring into the country? Can you dry the orphan's tear by enthusiastic eulogia upon the enterprise and energy of American industry? Call it not sentimentallity to sympathise with the mourning one though at the expense of national glory. Alas with man in the mad race for wealth and power, the lamentations of the bereaved are lost in the din of "the pomp and circumstance of glorious war," and the death of thousands by an agent of nature which *can* be curbed and controlled is forgotten amid the treasures which it strews in our pathway. That the lives of *all* who have been lost by what are by courtesy called "accidents" on board of steamers, could have been prevented by proper knowledge, and care is not to be questioned. Steam of too high pressure, and boilers of too poor construction have been too generally used. 4. As a body we fear that our engineers are not men who would compare favorably with those of England or France. We have too many *soi disant* engineers and too few who are worthy of the name. We are of opinion that engineers should be *students*, as well as the candidates for the "learned professions," nay *this* should be a "learned profession." Let there be a "society of civil engineers," whose business is to patronise, instruct, and send forth native talent, which shall do honor to the counrry, and write for themselves a history which shall be read by future times in noble bridges spanning great rivers, in "cloud capt towers," and in railroads and canals which shall convey man with the safety, pleasure and security of a morning walk, and with the swiftness of the morning light. Let our country take the lead in the onward march of science, let her enterprise and talent be faithfully *scientifically* and dillegently employed in "internal improvements." Let her works of art be models and not copies—let her engineers be *studious and careful* and we care not how fast they proceed, how much they innovate—provided they proceed upon "grounded conclusions," and scientific theory. Then may they hold to the entusiastic opinion of Brindley, and declare that the "Father of Waters" was made for a canal feeder, and the "everlasting hills to be tunnelled!

W. S.

The following communication presents a dismal picture of the untoward state of affairs as regards internal improvements in Illinois. Not that it is to be considered as offering arguments against internal improvement, but as affording a useful lesson on the mistaken plan of doing every thing at once, and nothing well.

Had the entire system for the State been carefully and judiciously matured, making a sufficient allowance for all probable increase in population and traffic—and then when so matured, taken up item by item as the immediate wants of the State required, we should not have heard of doings which unfortunately, have left such enduring monuments as to injure, we fear seriously, the good cause in that State at least.

A good system for the whole State, by no means requires simultaneous construction throughout the State. Each work may be undertaken as the traffic demands, and the funds allow; and yet when completed, is in no danger of being superseded by some other line; but each being a member of the whole, performs its parts both as an individual, and as a member.

It is reasonably to be supposed, however, that the cause of much of this ill-timed work, may be found in something else than an over-zealous patriotism in promoting Internal Improvements.

"From your connexion with Internal Improvements, you no doubt would feel some interest in knowing what has become of the "*splendid* system," projected and put in practical operation by the great state of Illinois,—the "*infant Hercules.*"

"Of something over 300 miles put under contract in '39, only 24 miles are completed, and in opperation, (from Meridocia, on the Illinois River, to Jacksonville.)

The graduation is completed on many *detatched portions* of all the different roads, and in many cases, something had been done towards the superstructure, but the pressure of the times—the failure of the State to obtain funds with which to meet the estimates, have forced the contractors to abandon their work, and there is not to my knowledge, one now at work in the state.

The system thus far has opperated injuriously, for the interest and credit of the State, and all classes of community. For the state *individually*—by prosecuting so many roads at one time, some of which were acknowledged to be of but little if any advantage, either to the commercial or agricultural interest of the State, by proceeding blindly to become involved to the contractors, before they had secured a sufficiency on permanent loans to meet the contracts; and by finally having a million of dollars of her own *promissory notes*, (and her scrip is hardly that) depreciated 100 per cent in her own state. Injuriously for the farmer, as he has been flattered into the feeling that he would by this system be secured a home market for all his produce, at as good, if not better prices, than could be obtained in the South or East. For the merchant, as where they have credited the contractors, they

have had to wait an unusual length of time, and finally take their dues in irredeemable scrip.

It is extremely doubtful with the most intelligent "suckers," whether the State will ever complete one half she has attempted.

At some future time, if I have leisure, I may give you some detailed statistics of our system for publication.

Yours respectfully, &c."

It is very seldom that we so far infringe upon the privacy of our correspondence, orthe patience of our readers, as to dole out to them the commendations of our personal friedds. We have often been advised to do so, but we must confess our great unwillingness to parade such things before our readers, however much they may contribute to our personal gratification.

We have, however, at precent a case before us, which not only demands our warmest thanks, but public thanks, although from delicacy we withhold the name. The gentleman is a distinguished engineer, and though well known to us by reputation, we are without the pleasure of a personal acquaintance. The communication was of course entirely unexpected and unsolicited. But when we are tendered *two years' subscription in advance* with a compliment in the bargain, we cannot refrain from giving our readers a testimony so highly gratifying and a guarantee for future endeavors on our own part.

"*July* 9*th*, 1840.

Gentlemen—I enclose a ten dollar note, to cover my subscription to the Railroad Journal, for two years from July 1st 1840, in advance. Up to that date my subscription is paid. * * * * * * I am very glad to see the manifest improvement in your Journal, both in appearance and matter, and hope you may enjoy the success which your industry and enterprise richly merrit.

Very respectfully, &c."

An Essay on the Boilers of Steam Engines, *their calculation, construction, and management with a view to the saving of fuel, including observations on railway, and other Locomotive Engines, steam navigation, smoke burning, incrustations, explosions, etc., etc.* By R. Armstrong, Civil Engineer.

Having procured this work for our own use, we have examined it carefully, and altho' not enabled on a first examination to pronounce upon certain portions—we see nothing so far to prevent us from warmly recommending it to engineers. The subject is well handled, and in such a practical manner, that it is brought within the comprehension of every class, while its results are followed up with immediate referrence to their mechanical application. There are some remarks upon explosions which strike us as sensible, and deserving consideration.

ANNUAL REPORT OF TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS.—Session 1840.

The council of the institution of civil engineers, on resigning the trust confided to them by the last annual general meeting, solicit the attention of this meeting, and of all those who are interested in the welfare of the Institution, to the following report on the proceedings and on the state and prospects of the Institution at the close of this the 21st year of its existence. At the last annual general meeting, the council of the preceding year had the gratification of congratulating the Institution on its then assembling in its new premises, under circumstances which furnished so advantageous a contrast with the condition of earlier years, and such convincing evidence of the steady progress and success which had attended the labors of the council and the co-operation of the general body. And though the year which is now closed upon you may not have been marked by events of so striking a character as the preceding one, the council nevertheless experienced the highest degree of satisfaction in reviewing the proceedings of the session of the year so auspiciously commenced. Aware of the more extensive duties and increased responsibility entailed upon them, the council have endeavored so to direct the affairs of the Institution as to keep pace with its growing importance; and they can with confidence assert, that the proceedings of the last session have not been inferior in interest or importance to those of any preceding session; whilst the attendance at the meetings, and the anxiety which is evinced by strangers to become acquainted with the proceedings and objects of the Institution, shew the estimation in which it is held both at home and abroad, and fully warrant the most sanguine anticipations of its future and continually increasing success.

The attention of the last annual meeting was directed to the expediency of some alteration in the existing laws, particularly with reference to the election of officers and the number of the council. It was suggested that the annual election of the council should be conducted in a somewhat different manner from that hitherto pursued; that a greater number than that constituting the council should be nominated, and that, consequently, each person at the annual general meeting, instead of, according to the then existing practice, erasing one name and substituting another, should erase as many names as the number on the balloting list exceeded the constituted number of the council. It was also suggested, that it would be for the advantage of the Institution that the council should be increased by the addition of two members: That as some members of the council are frequently prevented by professional engagements from regular attendance, the council should be enlarged to as great an extent as might be consistent with the true interests of the Institution. These and some other suggestions for the better regulation and stability of the Institution were subsequently submitted to a general meeting of members, and now constitute part of the bye-laws of the institution.

The practice of other societies in publishing their transactions in parts, containing such communications as were ready at frequent and short intervals, was briefly touched upon in the last report, and was discussed in considerable detail at the last annual meeting. Such is the nature of some communications, that delay in the publication may be considered not only as a positive injustice to the author, but as detrimental to the cause of practical scieuce and the best interests of the Institution; and if the publication of such papers he delayed until a whole volume is ready, authors

will inevitably avail themselves of other channels for bringing their labors before the world, Add to which, when a whole volume, containing many valuable plates, is to be published, the sources of delay are numerous, and such as cannot be avoided. The council conceive that the experience of the past year has fully borne out the preceding views, and shown the great importance and value of prompt publication. Early in the session the Institution received a most valuable communication from your member, Mr. Parkes. It was considered desirable that the publication of this communication, forming as it did a continuation of his researches already published in the second volume of the transactions, should not be delayed. No other communications being then ready for publication, the council resolved to publish it at once as the first part of the third volume. This has now been for some time in the hands of the public, and the number of copies which have been disposed of shows the great desire evinced to obtain these papers as soon as published. The council have also had still further proof of the importance of this plan. The Institution received during the last session several communications well suited for publication in the transactions, and among them the continuation and conclusion of that already mentioned by Mr. Parkes. Preparations were made for the immediate publication of these papers in a second part; difficulties and delays, which could not have been foreseen or prevented, occurred in the publication of some of them, and thus the second part contained but two instead of nine communications originally destined for it. The greater portion of the remaining seven papers are already printed and the plates engraved, so that the third part will be in the hands of the Institution in a very short time. There are several other valuable communications in the possession of the Institution now in the course of preparation for publication, and which will appear as soon as circumstances will permit.

The minutes of proceedings have been printed at such short intervals, during the session, as the abstracts of papers aud minutes of conversation would furnish sufficient materials. The council conceive that great advantages may, and indeed have resulted from a publicatiou of this nature. An authentic account of the communications is thus immediately furnished, attention is continually kept alive to the subjects which are brought beforc the Institution, and the statements there recorded have elicited very valuable communications, which otherwisc would very probably never have been called forth. No one can turn over the minutes of the last session without remarking the number and the diversity of the facts and opinions there recorded very many of which were elicited by the statements contained in some written communication, or casually advanced in the course of discussion.

The council cannot omit this opportunity of insisting on the importance of these discussions, in promoting the objects which the Institution has in view. The recording and subsequennt publication of these discussions are features peculiar to this institution, and from which the greatest benefits have resulted and may be expected, so long as the communication of knowledge is solely and steadily kept in view. It would be easy to select many instances, during the last and preceding sessions, of some of the most valuable communications to the Institution, owing their origin entirely to this source. The first communication from Mr. Parkes arose entirely out of the conversations which took place on the superior evaporation of the Cornish boilers being referred to as one cause of the great amount of the duty done by the cornish engines. The communication by Mr. Williams on peat and resin fuel owes its origin to his being accidentally present at the discussion on the uses of turf, in the manufacture of iron: whilst that by Mr. Apsley Pellatt, on the relative heating powers of coke and coal in melting glass,

arose entirely from the discussion of the facts stated by Mr. Parkes respecting the superior evaporation produced by the coke from a given quantity of coals, than by the coal itself. And lastly, the extremely interesting and highly valuable discussion at the commencement of the last session, on the uses and applications of turf; and on the extraordinary coincidence between the results obtaided by Mr. Lowe, Mr. Parkes, Mr. Apsley Pellatt, and Marcus Bull, of Philadelphia, experimenting as they did with totally different views, and under totally different circumstances, must be fresh in the recollection of all present.

But, besides the positive advantages which have thus resulted, and may be expected, from a steady adherence to these practices so peculiar to this Institution, there are others of the greatest value to those engaged in practical science. By this freedom of discussion, statements and opinions are canvassed, and corrected or confirmed, as soon as promulgated—the labors of authors and claims of individuals are made known and secured as matter of history—and attention is continually kept alive to the state and progress of knowledge in those departments of sciencc which it is the especial object of this Institutisn to promote. The council, trust, therefore, that those individuals who have stored up knowledge and facts for many years past, and devoted themselves to some particular branch of science, will consider how much they have in their power to contribute, and how great is the assistance which they can render to the laborers in other branches, and above all, to those who are ambitious of following in their steps, by freely communicating, either orally or in writing, the knowledge which they have collected; so that the records of the Institution may be unparalleled for the extent and correctness of the information which they contain.

The council have endeavored from time to time to direct attention to subjects on which it was conceived communications were needed or desirable, by proposing such subjects as objects for the premiums; placed at the disposal of the council by the munificence of the late president. The communications sent in compliance with this invitation have not been numerous. Two, however,—one by your associate Mr. Jones, on the Westminster sewage, and the other by Mr. Hood, on warming and ventilating, seemed to call for some special mark of distinction.

The communication of Mr. Jones is of the most elaborate and costly description. It consists of a large plan of the city of Westminster, drawn to a scale of one inch to 200 feet, compiled from the originals in the possession of the commissioners of sewers of that district. Upon this are laid down the boundaries of the city, and parishes, and all the principal streets and squares, with the main and collateral lines of sewers, differently colored, so as to be readily distinguished. This, with the Book of Sections, consisting of upwards 100 sheets of tables and drawings of details of levels, lengths, and construction, furnishes an exact and authentic record of a work of great magnitude. Any extended remarks on the benefits conferred on our metropolis, by the system of underground drainage, would be here superfluous. Works of this nature are of the highest public importance, and have been repeatedly the subject of legislatian by both general and local acts. The council conceived that, in awarding to Mr. Jones a Telford Medal in silver, and twenty guineas for this laborious communication, they were bestowing a suitable mark of approbation on the author of a record which is nearly unparalleled, and must be of great value as a source of information in all future works of this nature, when other, and particularly foreign, cities carry into effect a system of drainage, in which they are at present so deficient.

The council cannot pass from this subject without expressing the obliga-

tions which the Institution is under to the chairman and the commissioners of the sewers of the Westminster district. On its being intimated to them that the council wished some account and record of the work over which they preside, permission was immediately given for any person desirous of preparing such account to have free access to all the documents in their possession relating to the subject, and to make such extracts or copies therefrom as could in any way contribute towards this object.

The communication of Mr. Hood contains a detailed account of the principles on which the salubrity of the atmosphere in crowded rooms depends, and the various methods which have been adopted for warming and ventilation. The author has briefly touched on the various modes of warming generally adopted, and points out the great difficulty which exists of presering those conditions of the atmosphere which are essential to healthy respiration wherever close stoves or surfacec which may become too highly heated are employed. The importance of ventilation, and the success which has attended the adoption of mechanical means in the manufacturing districts, are subjects worthy the attention of all who study the health of those who, from choice or necessity, are exposed to the generally unwholesome atmosphere of crowded apartments. This subject is of the highest importance to the manufacturing poor of this country, who are compelled to work in crowded rooms at high temperatures. The council are aware that much has been done towards this object in some of the large cotton works of Great Britain, and they hope ere long to obtain some detailed account of the means by which this has been accomplished, and the results which have ensued.

The council have also awarded a Telford medal in silver to your associate, Charles Wye Williams, for his communication on the properties, uses, and manufacture of the turf coke, and peat resin fuel; and to Mr. Edward Woods, for his communication on locomotive engines.

The various applications of peat as a fuel had been repeatedly the subject of discussion at the meetings of the institution, and this communication may (as has been already noticed) be attributed to the discussion then going on. It is well known that the attention of Mr. Williams, as mnager of the city of Dublin steam packet company, and otherwise intimately connected with steam navigation in Ireland, has been for many years directed to the application of peat or turf as a fuel. Public attention was more than thirty years ago directed to this subject by Mr. Griffiths, who designated the bogs of Ireland as "mines above ground." The scarcity and cost of coal, as contrasted with the abundant supply and cheapness of peat, had long since led to the use of the latter in the steamers on the Shannon. Its bulk and tendeny to absorb moisture, are however, serious impediments to its use; but these may be successfully combated by care in the preparation. Moreover, the peat properly selected and prepared, being a carbon of great purity, is superior to every other substance, for all purposes of Metallurgy. But, in these researches, Mr. Williams had ulterior objects in view. He sought, by the preparation of an artificial fuel, to form a combination which should closely resemble the best kinds of natural coal, by combining with turf coke, resin, or some other bitumen of great purity, so as to produce a compound in which great heating power should exist in small bulk, and thus avoid the excess of bitumen and deficiency of carbon in the cannel coal, as well as the deficiency of bitumen and excess of carbon in the anthracite. It would be foreign to the object of this report to dwell on the preparation of this fuel, or the purposes to which it is applicable; it will suffice to refer to the numerous discussions on this subject recorded on the minutes of last session, and the paper now published in the second part of the third volume, of your transactions.

The communication by Mr. Edward Woods published in the second volume of the transactions, will always bear a prominent place among the records of practical science, as one of the earliest and most accurate details on the actual working of locomotive englnes. The first communication was received early in the session of 1838. The author was thought capable of adding so much to his already valuable communication, that the council referred it back to him for this purpose, and it was not received in the form in which it appears in your transactions, till after the premiums of that session were awarded. But this communication (notwithstanding the interval since it was laid before the meeting,) will probably be fresh in the recollection of most present, from its giving an accurate account of the progress of the locommotive engine on the Liverpool and Manchester railway, from the opening of that important work. The experience of engineers had at that time furnished them with but little knowledge as to what were the most essential requisites in railway engines, and the advance of knowledge as shown by the history of the locomotive engine on this railway, is a most interesting and instructivé lesson to every one who would study the progress of practical science and improvement. Great alterations were found necessary in the strength of the parts, in the weight of the engines, in the road, and the number of wheels. The first engines were gradually adapted to the necessities of the case, and the arrangements then resorted to as necessary expedients have now been adopted into the regular and uniform practice. Besides the extreme interest of that which may be termed the history of these improvements, the communication is replete with theoretical principles as to the working of locomotives, and the advantages and disadvantages incident to peculiar practical adaptations. It would exceed the limits of this report to do more on the present occasion than briefly to state that this paper contains extended remarks on the relative advantages of four or six wheels, of iuside or outside framings, of crank axles or outside crank pins, of coupled or uncoupled engines. The council would point out this paper to the junior members of the profession, as an example of how great a service may be rendered by simply recording what passes under their daily observation and experience.

The council have also adjudged a Telford medal in bronze and books to the value of three guineas, to Mr. R. W. Mylne, for his communication on the well snnk at the reservoir of the New River company at the Hampstead road; to Lieutenant Pollock, for his drawings and descripiion of the Coffre dam at Wesminster bridge; and to Mr. Redman, for his drawings and account of Bow bridge.

The cowmunication by Mr. Mylne contains an account of the various attempts which have been made in the metropolis and its environs to obtain water from the sand strata, by means of wells and small bores, in which the water rises naturally to the surface. These attempts, and the raising the water by artificial means from the sand strata, have beeu for the most part unsuccessful. In some cases, parties having communication with the same sand stratum and contiguous to each other, were unable to obtain water at the same time, as the drawing water by one had the effect of destroying the supply of all the others. In other cases, the sand coming away with the water, large cavities were formed of such a nature as, after a short time, entirely to suspend the progress of the works. Of the latter difficulty, some remarkable instances occurred during the sinking of the well in the Hampstead road, which are particularly described in the communication. The supply of water from the sand being, from the causes just alluded to, very precarious, the New River company, in March, 1835, determined on sinking a well through the clay and sand into the chalk, for the purpose of ascertaining the supply of water from this source. The peculiar di-

fficulties experienced in the progress of this work, and the means by which these and similar difficulties are to be overcome, as set forth in the report of Mr. Simpson, appended to the communication, furnish a valuable compendium of information on this subject; and, being replete with practical details of an executed work of no ordinary difficulty, is one of those communications to which the council are most anxious to give every encouragement in their power.

The communication by Lieutenant Pollock on the Coffre dam now fixed round the 13 and 14-feet piers of Westminster bridge, and by Mr. Redman on the new stone bridge over the river Lea, at Stratford-le-Bow, are of a similar character with the preceding; they are both accurate acconnts, accompanied by valuable drawings, of important works actually executed. The collection of such records ought ever to be a primary object with the Institution, and their authors are most justly deserving of such marks of distinction as it is in the power of the Institution to bestow. The coucil would point out the above as instances of the facility with which individuals may contribute to their own advancement and repfitation, no less than to the objects which the Institution has in view; and would more particularly advert to Lieutenant Pollock, who, while in England, on leave of absence from India, oceupied himself in acquiring engineeriug knowledge, and with most praiseworthy dilligence, availed himself of the opportudities afforded him of observing and recording the progress of the works at Westminster bridge. Works of this natnre are accsssible to most of those who are studying for the profession, and by making use of the opportunities which are afforded them, they will be able to prepare communications most deserving of such distinctions as those which have just been conferred.

Among the other communications of the session, the council cannot, on on the present occasion, omit to notice those of your member, Mr. Parkes. His communication on the evaporation of water from steam boilers, for which a Telford medal in silver was awarded during the preceding session, and the interesting discussion to which it gave rise, are too well known to require further comment. But great as were the benefits conferred on practical science by the facts there recorded, they have been much surpassed by the subsequent labors of this author. In continuation of his subject, you received early in the session, the first part of a communication on steam bailers; and at the close of the session, the seeond part, treating of steam engines. Before Mr. Parkes was induced to turn his attention to the preparation of these communications, no attempt had been made to bring together, in one connected view, the various facts which had been ascertained. The economy of the Cornish system was indisputable; bst to what it was to be referred was involved in in some obscurity. It was reserved for this communication to call attention to certain quantities and relations which exerted a peculiar influence over the results; and which, being rightly ascertained, were at once indicative or exponential of the character of the boiler. If it be found that, in one class of boiler, the same quantity of coal is burnt eight times as rapidly as in another class—that the quantity consumed on each square foot of one grate is twenty-seven times that on the grate of another—that the quantity of water evaporrted bears some definite relation to the quadtity of heated surface—and that there is twelve times more evaporated by each foot of heated surface in one class of boiler than in another —and finally, that the quantity of water evaporated by a given weight of fuel is in one class double the quantity evaporated in another,—we have arrived at some definite relations whereby to compare boilers of different kinds with each other.

To these definite quantities and relations, the author with apparent proprie-

ty assigns the the terms "exponents;" and these being compared together for different boilers, their respective merits as evaporative vessels are readily perceived. Mr. Parkes has also called the attention of engineers to the effect of the element time, that is, the period of the detention of the heat about tne boiler. The importance of attending to this cannot be too strongly insisted on; as it would appear from these statements, that boilers being compared with each other, in respect of their evaporative economy, arc nearly inversely as the rate of combustion. Attention is also called to the fact, that there are actions tending to the destruction of the boiler, entirely independent of the temperature of the fire, and which may be designated by the term "intensity of caloric action." Of their nature we know nothing, but the durability of different boilers, under different systems of practice, affords some means of comparing the intensity of these actions.

Mr. Parkes having, in the first part of the subject, thus pointed out the distinctive features of the different classes of boilers as evaporative vessels, proceeds, in his subsequent and concluding communication, to consider the distribution and practical application of the steam in different classes of steam engines. And for this purpose, he is led to consider the best practical measure of the dymanic efficiency of steam—the methods employed to determine the power of engines—the measures of effect, the expenditure of power—the proportions of boilers to engines—the standard measure of duty—the constituent heat of steam—the locomotive engine—the blast and resistence occasioned by it—the momentum of the engine and train, as exhibiting the whole mechanical effort exerted by the steam—the relative expenpiture of power for a given effect, by fixed and locomotive non-condensing engines. This bare enumeration of the principal matters in the second communication, will give some, though a very inadequate, idea of the magnitude of the task undertaken by Mr. Parkes, for the communication is accompanied by elaborate acd extensive tables, exhibiting the results of the facts which he has collected and used in the course of his inquiry, and it may confidently be asserted, that a more laborious task has rarely bean undertaken or accomplished by any one individual than the series of communications thus brought before the Institution.

It will be one of the earliest duties of the succeeding council, to consider in what manner the sense of the great benefits conferred to this department of practical science, can most appropriately be testified.

The council also received, at the close of last session, from your member Mr. Lesslie, a most valuable communication on thc docks and harbour of Dundee. This is one of the records on which the Institution sets the highest value, being the detailed account of an executed work of great extent. It is not, in its present form, well adapted for being laid before the meetings; but on its publication, which will take place vepy shortly, the Institution will have an opportunity of judging of the high value which it possesses.

In acknowledging, with gratitude, the numerous and valuable presents made to the Institution during the past year, the council would call the attention of the members generally, to the want still existing in the library of works of reference on general scientific subjects not immediately connected with engineering, and express a hope that such wants may be supplied by that liberality to which the Institution is already so deeply indebted. The collection of models, also requires many additions to render it as complete as the council could wish; and it is only by the wants of the Institution being constantly borne in mind by all who are interested in the subject, that such a collection can be formed as shall be worthy of the society.

Several societies have made an exchange of transactions with the Institution; and from the Royal Society of Edinburgh, the Philosophical Society

of Manchester, the Royal Irish Society, and the astronomical Society, sets of transactions, as complete as could be made up, have been received. The Master-General of the Ordnance, the Lord Lieutenant of Ireland, and Col. Colby, continue their liberal presents of the English and Irish surveys; and captain Beaufort and the secretary of the Admiralty have continued the presents of the series of admiralty charts. The Institution is also indebted to Mr. Vignolles for the busts of Locke and Dr. Hutton; to Mr. Field, V. P., for a bust of the late Henry Maudslay; and to Mr. Rivers, for that of Dr. Faraday.

The council would wish to take especial notice of the large collection of works of the late eminent philosopher, Dr. Young, now deposited in your libaary. For this great acquisition the institution is indebted to the kindness and liberality of his brother, Mr. Robert Young, who conceiving most justly that every thing connected with so great a benefactor to practical science, mnst be highly valued by this institution, has made it the depository of these books, from the library of his distinguished relative. The council, in thus publicly recording their sense of the kindness and liberality of Mr. Robert Young, would carnestly press upon others the importance of following so noble an example, and of presenting such works as are at their disposal, and of which the library of the Institution is particularly in need.

It was announced, through the medium of the last annual report, that the monument of Telford was nearly finished, and that a site had been selected in Westminster Abbey. The council have now the satisfaction of announcing, that the monument is fixed in the place destined for it, and they are confident that all who enjoyed the acquaintance, or knew the merrits of the late disntinguished President of this Institution, will rejoice that the memory of one so eminent and so highly deserving has met with so proper and just a tribute of respect; whilst all, no less than those by whose liberality the monument was erected, will feel that he has a name which will endure so long as there exists a record of the triumphs of the British engineer.—*London Journal of April and May* 1840.

PRACTICAL DEFICIENCIES OF SCIENTIFIC WORKS.

(From the "Adventures of the Missionary Williams.")

After some deliberation I determined to attempt to build a vessel; and, although I knew little of ship-building, and had scarcely any tools to work with, I succeeded, in about three months, in completing a vessel between 70 aad 80 tons burden, with no other assistance than that which the natives could render, who were wholly unacquainted with any mechanical art. I thought at first of getting the keel only at Rarotonga, and completing the vessel at Raiatea, but, as the king, chiefs, and people, urged me to build it at their island, promising me at the same time, every assistance in their power, I yielded to their wishes. As many friends have expressed a desire to know the means by which this great work was effected, I shall be rather more minute in detailing them than I should otherwise have been.

My first step was to make a pair of bellows; for it is well known that little can be done towards the building of a ship without a forge. We had but four goats upon the island, and one of these was giving a little milk, which was too valuable to be dispensed with; so that three only were killed, and with their skins, as a substanee for leather, I succeeded, after three or four day's labour, in making a pair of Smith's bellows. These, however, did not answer very well; indeed I found bellows-making to be a more difficult task than I had imagined, for I could not get the upper box to fill properly; in addition to which my bellows drew in the fire. I examined publications upon the mechanic arts, dictionaries, and encyclopædias, but

not one book in our possession gave directions sufficiently explicit for the construction of so common an article; and it appears to me a general deficiency in all the works I have seen on the useful arts, that they do not supply such simple instructions and explanations as would direct to the accomplishment of an important and useful object by means less complex than the machinery of civilized countries. When, for example, we were anxious to make sugar, and, for this purpose carefully read the article on sugar-boiling, in the most popular Encyclopædia in our possession=not having the apparatus therein described—we derived no practical benefit from it. If, in addition to a thorough and scientific description of the most perfect methods, there were appended plain and simple directions for manufacturing the article without the expensive machinery in common use, it would certainly be of immense service to persons situated as we, and emigrants to new colonies have been, These remarks are applicable to soap-boiling, salt-making, paper-manufacturing, and a variety of other processes of a similar nature.

Missionaries, and others leaving the country, when in search of information upon various important subjects, generally fail in their object, by seeking it where every thing is effected by complicated machinery, and all the improvements of the present age are found in perfection. It was so with us. We were taken to places of the above description—we gazed, we wondered, and were delighted, but obtained no practical information; for few imagine that there is any other way of effecting an object than that which they see. All persons going to uncivilized countries, especially missionaries, should seek that knowledge which may be easily applied, as they have to do every thing themselves, and in situations where they cannot obtain the means in general use elsewhere. It may, by some, be thought unwise to go back a hundred years, and employ the tedious processes then in use, rather than embrace the facilities which the experience of succeeding ages has afforded. But such an opinion, although specious, is unsound. Let the circumstances of the missionary, and the state of the people to whom he goes, be taken into the account, and it must be at once obvious, that the simplicity of the means used two or three hundred years ago, would better suit both his condition and theirs than the more complex improvements of modern times.

(From "Armstrong on Steam Boilers.")

ON BURNING SMOKE.

In nothing has the philosophical manufacturer or amateur mechanic been so much at variance with facts and the experience of practical men, as on the subjdct of *smoke burning*. It is perfectly true, that the black carbonaceous matter which usually escapes along with the incombustible gases, and which is the only *visible* constituent of what we term smoke, is all so much fuel, and when properly consumed under the boiler is undoubtedly a saving of coal: bu it unfortunalely happens, that the saving is such an inapplicably small quanity, that none who have tried it have been able to calculate its amount, except in certain cases, when it has taken the so much dreaded negative form. It is far from my intentionto speak disrespectfully of any of those who have proposed to save fuel by burning smoke, for they have generally deceived themselves before they led others astray, as the hundreds of patents, as well as the hundreds of thousands of pounds that have been expended over them, amply testify; indeed they deserve no small share of our gratitude from the opportunities the subject has given of ascertaining by experiment, a great number of practical results which we can now make available in other more important improvements.

This suqject is introdnced here because it is closely allied to the one we have just been considering, namely, that of enlarging the furnaces of boilers; and I speak with the more confidence in this particular, from having had a good deal of practice in directing the application of several of the various methods of smoke burning which have been tried in this country, since the legislature made it in some measure compulsory. Several boilers are now working in this district, which have undergone various improvements under my directions, and with which I had undertaken to *save fuel*, and at the same time *burn the smoke*, and which were in almost every case successful; but mind, the fuel was not saved *by burning the smoke*, but by the adoption of various alterations and arrangements which the previous defective proportions or bad management of the particular boilers admitted.

Very few instances occurred where the attempt might be called a signal or total failure; and a failure in smoke burning is usually signal enough. There is a very common answer which enginemen are in the habit of giving to their employers when questioned as to why they allow so much smoke to fly away without burning it; it runs thus,—" Master, if you will only tell me how to catch it and bring it here, I'll be bound to burn it." Now, in the year 1829, a gentleman in a neighbouring town (Joseph Jones, Esq., Walshaw Mills, Oldham.) put the idea contained in this joke to the test of experiment, and it arose from the circnmstance of his having two steam engines, one situated at the foot of a hill and the other near the top, so that the smoke from the lower engine was carried through a tunnel or flue up the side of the hill, which in some measure answered the purpose of a chimney, and escaped by a shaft or stack near the higher engine. Consequently the situation admitted of great facility in arranging a plan for setting the question at rest, as to whether any saving was to be made out of burning the smoke or not; and as it was intended to be a sort of *experimentum crucis*, I willingly engaged to superintend the putting it of the upper engine, in order to admit of the whole or any portion into practice. Accordingly we had alterations made in the furnaces of the smoke from the lower one, without any obstruction to the draught of either. Proper valves and dampers were fixed for the purpose of admitting and regulating any required portion of atmospheric air, in order to supply the neeessary quantity of oxygen to the new combustible And, in fact, from 30*l.* to 40*l.* was expended in apparatus, so that nothing should be omitted which had any chance of securing the success of the experiment; but it was all of no avail, and the result was as already stated. The smoke to be sure might be sad to be *burnt*, for it passsd through a very hot furnace, but it certainly was not *consumed* as usually understood, for it always appeared to me to be much blacker at the chimney top after having passed through the furnace, than it did when it was allowed to pass off without going near the fire at all And as to the saving of fuel by the process it may safely be pronounced *nil*, for unfortunately we were never able to raise sufficient steam with it to keep the engine going for a quarter of an hour together.

The circumstances attending the above experiment are stated, because we believe it to be the first of a series of attempts to consume smoke by combustion, according to a principle lately revived by numerous patentees and experimenters in this neighbourhood, although originally suggested and patented by the late Mr. Watt, in 1785. The great secret of smoke burning, however, is now pretty well known to practical smoke burners. and that is, either to make very little (*or none*), to burn, or otherwise so to dispose of the fuel in the furnace, that smoke of such a quality only is made, as will burn comparatively easily; and in either process the saving in fuel is a point yet unsettled.

In the first case, by keeping a thin fire, and throwing on the coal by a very small quantity at a time, which is most advantageously done by the firing machine. and with a free access of air through the grate, we are assured that no *combustible* gases escape from the furnace; consequently the very small quantity of solid carbon held in suspension (principally by the extricated azote and other *incombustible* gasses) is the only portion of the smoke capable of combustion, and to effect which, a most intense heat with a rapid supply of oxygen is necessary, and in a much greater degree than the ordinary economy of a steam boiler requires.

In the other case mentioned, in order to produce smoke that will burn more easily, it is requisite that a large quantity of coal be laid on at a time, and also to have a slow draught, so that nearly the whole of the carbon evolved is combined in the production of carburetted hydrogen gas. In fact, the furnace with a thick fire, may be likened to a gas retort, and the carburetted hydrogen thus distilled forms an explosive compound when mixed with a fresh supply of atmospheric air at the bridge of the furnace. This last is on the principle of Mr. Parkes, whose system of smoke burning came so much into favour some years ago, but which is now nearly extinct, although it is yet a point much debated, whether a thick fire with a slow draught, or a thin fire with a quick one, and its necessary accompaniments, a firing machine, and a good chimney, is the most economical.

The very general adoption by the Lancashire manufacturers, of Stanley's firing machine, and Walmsley's moving fire bars, would seem to be decisive of their general economy in preference to any system of firing and stoking by hand; but there are other causes for this preference, quite independent of the question of economy of fuel, some of which have had great influence in the general disuse of Mr. Parke's system of firing; one of which is, that in the latter system, the boilers are required to be considerally larger for the same power, a fatal objection here, but which is more or less applicable to every system of smoke consuming that we are acquainted with. The force of this objection, will be felt at once by those who are acquainted with the practice of the great majority of the Lancashire cotton spinners, which is that of using their steam engines, as some people do post horses, by making them do as much work as ever they can, short of breaking down. The same remark is also applicable in some degree to the Liverpool steam vessels; they are made to go at their utmost speed, in order that as much work may be got out of them as possible, and in as short a time; although, owing to their being generally the property of Joint Stock Companies, they have, as in the case of most monopolies, not as yet been sufficiently subjected to the stimulus of competition and individual enterprise.

The general facts above mentioned are so well known to every experienced fireman and operative engineer, that the saying has almost passed into a proverb with them, absurd as the connection may appear, that, "*it requires plenty of boiler room to burn smoke;*" and we know that many of them consider it as easy to drive a 30 horse engine with a 20 horse boiler, if fired upon Stanley's plan; as it is to drive a 20 horse engine with a 30 horse boiler, upon the principle of Parkes. The observations of this class of men are frequently more worthy of regard than inventors of new plans are generally disposed to pay to them. More especially if we consider that this "instinct of ignorance," as it has been called, enables them to manage all the various complicated arrangements of the fires, engines, and boilers of that wonder of the present age, the "Ocean Steamer," in a manner that we are afraid will not be much improved upon, for a few years to come, by all the engineering classes of our new universities. At any rate, if a little more attention is paid in future to this "instinct," or tact," by some of the marine ma-

nagers and other supernumeraries of more than one or two of our extensive steam navigation companies, we may be spared the mortification of hearing of such unfortunate attempts in *smoke burning*, as that which is said to have caused the untoward return of the "Liverpool" steamer to Cork, when on her first voyage out to America.

Soon after the unsuccessful experiment of Mr. Jones, already detailed, loom, &c., made an ingenious attempt to bring Mr. Watt's principle Mr. Horrocks of Stockport, the well known improver of the power to bear, and although only partially successful, it forms one great step towards its ultimate accomplishment. Instead of taking the smoke of one fire over the top of another, he caused it to return over the same fire from which it was evolved. This he contrived by means of a most ingenious adaptation of the centrifugal fan, or rotatory blowing apparatus. It was worked by the engine at the rate of about 1,500 revolutions per minute, and so arranged that the smoke was drawn from the flue at the further end of the boiler, to the front, whence it was propelled down upon the hottest part of the fire, where its combustion was effected, although imperfectly.

About the same time that Mr. Horrocks was carrying on these experiments, fans were used by Messrs. Braithwaite and Erison, and others, both for locomotive engines and steam boats. Fans have been also applied by many, both before and since that period, for the purpose of obtaining an artificial blast or draught for the furnaces of steam engines, according as the propelling or exhausting power of the fan employed, but we believe none of them ever employed it for the purpose of returning the smoke into the furnace again. To Mr. Horrocks, perhaps, is also due the merrit of first employing both the exhausting and propelling action of the rotatory fan at the same time and in the same process, this double action being carried on in a furnace almost entirely inclosed from the external air.

The next attempt to follow up this principle of burning smoke, has been very recently made by Mr. David Cheetham, Jun., of Stayley bridge; but as at the time of writing this, the specification of his patent has not yet been published, a brief notice of it will suffice here.

As in the Stockport experiments, Mr. Cheetham also employs a fan, and nearly in the same manner; but instead of passing the smoke over the top of the fire, as was done by Mr. Horrocks, and also by Mr. Jones, of Oldham, as before stated, he sends it into the ash-pit, (which is inclosed,) whence it is by the joint propelling and exhausting action of the fan forced to pass through the fire-grate itself; by which means the flame and hot air in the furnace is propelled with great velocity directly up against the boiler bottom, a circumstance which sufficiently accounts for a considerable portion of the economy of the proeess.

But there is also another peculiarity which distinguished this invention from that of Mr. Horrocks, which is, that the small quantity of atmospheric air necessary to supply oxygen to the furnace, is admitted to the fan by an adjustable aperture, and allowed to become heated by intermixture with the smoke and hot air, as they are returned to the ash-pit. Thus the process acquires many of the well-known advantages belonging to the hot-air blast, as used in metallurgic operations. The saving in fuel is stated by the patentee to be about 20 to 30 per cent, and we have had opportunities of ascertaining, that in some cases the statement is not overrated; but how much of this saving is to be ascribed to the improved draught, and the peculiar application of the hot air blast, or whether any portion of it is derived from the the actual combustion of the smoke, there have as yet been no direct experiments to prove.

In the course of our practice in saving and fuel burning smoke

we always found that nothing tended so much to the accomplishment of both these objects as enlarging the furnace and flame bed, and where the draught of the chimney was good, also enlarging the fire-grate. In adopting this last alteration, it was always found that the maximum effect was produced when the area of the fire-grate was increased in a somewhat greater ratio than the effective heating surface was diminished:—that is, when a certain effect is to be produced, say, for example, an evaporating power equal to the supply of a twenty horse engine, which, we have seen, requires twenty square yards of effective heating surface, but from malconstruction of the boiler or other circumstances we have only eighteen yards, then the furnace will require to have a fire-grate of a *little more* than twenty-two square feet in an area; or if the heating surface be only sixteen yards, then the fire-grate will be required to be *more than twenty-four*, in fact about twenty-five square feet.

NOTE.—We happen to have met in our own experience with a confirmation of the above, and have frequently adverted to it, as a useful hint in "smoke burning," and "spark catching." Moreover, we consider it the more valuable because it shows that many, if not most, of those who have attempted to accomplish that object, having gone "right the wrong way," to work. Besides it is one of those cases where any thing else than a correct "theoretical" knowledge of the subject can afford no sound basis for "practical" operations.

In the summer of 1836, by the politeness of the directors of the Utica and Schenectady railroad, we were invited to be present at the opening of the road. On our return from Utica, wishing to avail ourselves of the opportunity of a remarkably fine day, we took our seat on the top of the cars, to enjoy the pleasure of a moving panorama of the beautiful valley of the Mohawk.

The engines were new, the wood not of the best kind, and the engineman labored, of course, under the disadvantage of an unaccustomed route. Huge volumes of smoke rolled from the chimney, and a stream of fire in the shape of sparks or rather flake of ignited coal, flew around and rather diminished the pleasure of our outside seat. Presently the conductor came to us and observed, that on account of the difficulty of making steam it would be necessary to remove the wire gauze chimney cap, and that it would no longer be safe to remain outside, on account of smoke and sparks. We remarked, the remedy for a bad draught should also be one for sparks and smoke; and as it it would not be worse than it then was, we should prefer to remain. Of course leaving us to be burned up at our pleasure, we had a chance to ascertain the effect. The cap was removed, and after the first rush, *the smoke became far less in quantity, and the sparks diminished in number and size*,—it was actually more comfortable than before. It was apparent, that a more perfect draught had consumed the fuel to little advantage.

In the case alluded to by Armstrong, instead of pure air, a quantity of cold and incombustible matter (under the circumstances) was thrown through the furnace. We say cold and incombustible because without a

far higher heat and an abundant supply of air (neither of them attainable by the means described), the smoke introduced really was so.—[ED. R. R. J.]

NOTE BY THE AUTHOR.

Since this article was printed, it has been ascertained that at least one half of the saving to be derived from the use of Mr. Cheetham's patent smoke burner, arises from the circumstance of keeping the ash-pit constantly closed up, thereby preventing any indraught of cold air through the flues during the night or at any other times when the engine is not working. This is a most important part of the economy of the process, and is called by some gentlemen of Stayley bridge connected with the patent, "*bottling up the heat.*" Of course this part of the invention can easily he used at all times when the engine stops, independently of that for the combustion of smoke, and it has now been so used in several instauces. I have been informed by a manufacturer, (John Leech, Esq., of Staleybridge,) who has proved it experimentally on a large scale, that the saving to be effected by this part of the invention, is about 12 per cent. Nothing can be more satisfactory than the mode in which this gentleman conducted his experiments. His plan was to work his boilers a whole week from Monday morning to Saturday night with the apparatus attached to all of them, (13 or 14,) and the succeeding week without the apparatus, and so on alternately for a great number of weeks, noting the consumption of fuel at the end of each. The correctness of these experiments was sufficiently proved by the fact of the saving remaining constantly the same, or at least not varying more than one per cent, on each side of the average of 12½.

The specification of the above patent may be seen in Newton's London Journal of Arts, Sciences, &c., for April 1839. As a *bona fide smoke burner*, it may be stated to have been, when carefully applied, more generally successful than any other that has been introduced in the manufacturing districts. I intend investigating the merrits of this and other plans for consuming smoke, in my forthcoming work on Chimneys and Furnaces.

The practice of closing up the ash-pits of steam engine furnaces, except a very small portion at the upper part nearly close under the front of the fire grate, is very common, and I have long recommended it as the best means of ensuring the fuel to be consumed on the front of the grates quickly as at the back, thereby keeping the fire of a uniform thickness; but to effeet this object in the best manner, the opening is required to be of the full width of the fire grate, so as to allow a thin stratum of air to pass nearly horizontally to the under side of the fire bars, and then, by properly adjusting the height and the area of this opening, the air can be caused to impinge nearly uniformly on all parts of the grate.

It is very easy to use this opening to the ash-pit as a regulator for the fire instead of the damper, but I consider that it is highly objectionable to do so, although it is recommended by Tredgold and other authors, besides having been recently put into practice in some of the atlantic steamers. One of my reasons against using the opening in this way, is, that there can be only *one* position of it, which is the best for the particular furnace and system of firing it is used with,—this, when once found, of course necessarily excludes any alteration without liability to injury. Besides the *quantity* of air admitted can be quite as easily regulated by the damper in the chimney flue. The damper, in fact, ought to be confined exclusively to the purpose of only regulating the quantity of air admitted, so as to suit the varying demands of the engine for steam; while the ash pit regulator is used for giving a proper direction to the current of air, and also to shut the latter off entirely.

When the ash pit regulator consists of an aperture and sliding plate of six or eight inches square in the centre of the front of the ash pit, it is then perhaps of the worst possible kind, as it causes the air to act on the centre of the fire like the concentrated blast of a blow pipe or bellows, and most destructively on some particular portions of the boiler, which as well as the grate bars becomes very speedily burnt out. This effect, however, is not so liable to be produced in the case of factory boilers, or those which are fired by machines and have moveable bars, as it is in that of locomotive and marine boilers. The latter are more especially liable to become burnt out in this way owing to the usual system of firing pursued in steam vessels, and which is very properly called *charging* the fires,—the operation being in fact more like that of charging a retort for making gas than any thing else.

It is unnecessary to repeat here opinions expressed in the body of the work in favor of thin fires and quick combustion for land boilers, as it may be said to be a point yet open to discussion; the system of *slow* combustiou having lately received a talented advocate in the author of a paper read before the Institution of Civil Engineers last winter. But respecting the applicability of slow combustion to steam navigation, it is impossible that there can be two opinions amongst engineers. *A thin fire and a quiek draught* are the great essential points to be attended to in steam packet boilers, and will always be synonymous with plenty of steam and a quick passage.

Mr. Josiah Parkes, who is the great propagator of the principles of slow combustion, admits that it requires about seven times the area of heating surface to produce the same evaporative effect by it as by the ordinary practice; a sufficient disqualification against its adoption in steam packets. It has been sufficiently proved, that, with the common Lancashire coal, a greater area of properly disposed effective heating surface than a square yard to each horse power is not advisable as a means of economy at the ordinary prices of materials and cost of management, in the case of land boilers in the cotton manufacturing district, or, in other words, any saving that would arise from an extension of the heating surface of a boiler beyond this limit, would be overbalanced by the ordinary interest for the outlay of capital and other contingent expenses in obtaining it. Henee, how outrageously absurd it is to expect to derive any great increase of profit from the adoption of the system of slow combustion in steam vessels, when we consider that not only are the boilers of the latter (from the necessities of construction) about double the weight and three times the cost of land boilers of equal power, but there is also to be reckoned the cost of carrying them, or the displacement of so much valuable cargo, although there is a set off against this to a certain extent, on the account of the expense of carrying the extra coal or rather *half the coal* that would be saved by the enlargement of the boiler. This, however, is a matter of the simplest possible commerctal calculation; for example:—if by doubling the size and weight of a steam packet boiler a saving in fuel can be effected of *five per eent.*, (a supposition which I by no means admit as probable,) and supposing the fuel to be consumed gradually from the commencement to the termination of the trip, then the proper deduction on this account for lightening the load of the vessel will be *two and a half per cent*, while, on the other hand, what is saved in boiler room must be reckoned at its full amount as permanent available profit.—If calculated in the same manner, I have no doubt but that the much vaunted saving by working marine engines expansively will be found to be very small indeed, unless the steam is raised to so high a pressure as to become dangerous. Raising

the steam to a dangerous pressure in the boiler merely for the purpose of expanding it again in the cylinder at a greatly reduced power, —as well as the system of slow combustion and wire-drawing the smoke through long winding flues in order to save a modicum of coals, are at best but philosophical niceties that are quite out of place in an Atlantic passenger steam ship in the present early stage of steam navigation. In short, wire-drawing the steam and wire-drawing the smoke, are in this case equally dangerous and useless, and the sooner steam packet proprietors dismiss them and attend more to a radical reform in the construction of their boilers, the quality of their coal, and the management of their fires, and, above all, to some more efficient means of propulsion than the present lumbering paddle wheel, the sooner they will accelerate the passage from Europe to America.

A slight consideration of the above principles, and a proper application of the rules contained in this work, will prevent any one getting so far wrong as some few influential parties connected with the commercial steam marine of this country have unfortunately had the means of doing; I say unfortunately, because extensive loss of life has already taken place, and must inevitably occur in future, in an increasing degree with the rapidly increasing number of steam ships for long voyages, unless the managers and engineers concerned unite a sound practical knowledge of the subject with a willingness to learn more from whatever source it may be offered, rather than the flippant parade of pseudo scientific acquirements that is sometimes to be met with, and which on application to new circumstances is always found to be miserably inefficient for any thing but failure.

The above sentiments are far from being meant to reflect invidiously upon any particular steam packet company, but, to a certain extent, they admit of a general application, and in excuse for saying this, I need hardly state that the subject is one of great public concern where the lives of thousands of passengers are daily intrusted to the care of hands wielding such an unseen and tremendous power as that of steam. With respect to the misapplication of capital and waste of property involved in the mismanagement of marine boilers, it may seem not a proper subject for animadversion, as the owners must in time "find it out," and some of them have commenced finding it out very speedily. As an illustration of this expensive way of trying experiments, it will be quite sufficient to mention the "Liverpool," which was the first steamer from Liverpool to New York belonging to the Transatlantic Steam Ship Company. In this vessel it was determined to try the celebrated Cornish principle of *slow* combustion, in order to burn the smoke, on her first voyage; this was effected by a misapplication of Mr. Parkes's principle, namely, *by allowing a constant stream of cold atmospheric air to pass into the flues of the boiler through a large aperture opening from the ash pit to behind the bridge of each furnace*; which aperture was *without a valve* or any other means of closing it at the discretion of the engineer. The consequence was, that although the engines, &c., were in every respect excellent, as well as the vessel itself, the latter after proceeding nearly half way across the Atlantic was compelled to return to Cork, where, of course, the patent smoke burning holes were stopped up before she proceeded again to her destination.

The Havana Railroad, a work of 45 miles in length, connecting that city with Guines, on the south side of the island, is doing a profitable business. The receipts for travel and transportation in seven months were $225,191—yielding a clear profit of fifteen per cent.

We are happy in being able to announce to our readers, that we have completed an arrangement with Mr. L. Klein, the accomplished assistant of the late Chev-de-Gerstner, whereby Mr. K. is to become a regular contributor to the pages of the American Railroad Journal.

When it is recollected that Mr. K. has been the constant companion of the late Chev-de-Gerstner, and has at present possession of his papers—we hope that in securing the services of Mr. K., we convince our readers of our disposition to spare no pains to render the Journal moreand more valuable.

Eratta.—On our first page the name of "M. Daguerre," is uniformly mispelt, "Daguenis."

ADVANTAGES OF IRON COMPARED WITH WOOD STEAMERS.

1. The first cost of an iron vessel is from fifteen to twenty per cent. less than a wood vessel.

2. The capacity of an iron vessel is much greater than that of a wood vessel of the same dimensions, in consequence of the less space occupied by the material; an iron vessel of four hundred and thirty tons would present about the same internal surface as a vessel of five hundred tons built of wood.

3. The weight of an iron vessel is not more than two-thirds of that of a wood vessel of corresponding tonnage; hence the displacement of the iron vessel is much less; therefore the diminished power of her engines, and comparative quantity of fuel required, makes the combined displacement very much in favor of the iron seamer.

4. An iron steamer is of much greater durability, without the repairs rendered necessary by the common wear and tear of wood steamers. It was stated before the House of Commons, that an iron vessel had been worked for thirty-six years, and that an iron steamer had been constantly employed for sixteen years, and at the expiration of that time her bottom was examined and found free from oxidation, the outer scales and rust had disappeared, leaving the bottom perfectly smooth and clean. Now a wood vessel during that time would have required her coppor to have been four times renewed, as often recalked, paid and painted, besides frequent and small repairs in replacing defective wood, and at the expiration of that time either condemned or thoroughly repaired, aud if we add the value of the time required to effect such repairs, the economy of using iron steamers will be enormous.

5. Perfect safety from fire is another of the great advantages to be realized by adopting iron steamers. The returns of steam vessels lost in one way or another, demontsrate that *a great proportion of these lossss have arisen from fire.* It naturally follows that the premium for insurance would be much less for iron vessels than wood. The present custom is the use of wood beams and deck, but were it necessary for still further security, iron might be substituted with equal ease for both.

6. The danger of the vessel's sinking by springing a leak, if not entirely obviated, is very much lessened. The facility of dividing an iron vessel's hold into departments by iron bulk heads, which can be made as tight and as strong as a boiler, is very obvious; therefore if a leak takes place in any one division, that division may be filled as high as the outer surface of the water, and the vessel be still comparatively secure. Moreover, a leak at

sea, on board an iron vessel, may be much more easily discovered than it could possibly be on board wood vessels, as it would not be hidden by a mass of timber. Another advantage would be a perfect freedom from the smell of the engine-room, which could not reach the cabins, and an entire absence of bilge water, so offensive on board all wood vessels. The plan of dividing the hold of wood vessels by means of partitions, will doubtless answer some good purpose, but where so intense a heat exists as in the interior of of a steamer, the wood must and will draw; this, added to the working of a wood vessel, would render it absolutely impossible to make the bulk-heads tight.

7. The kanger from lightning is very much diminished, as the whole body of the vessel is a conductor of electricity. Lardner's voyage to Africa in an iron stermer, coroborates this fact, and I find the opinions of the most scientific men concur on this subject. The captian of a steam vessel, who commanded a steamer on the Mississippi more than twenty years, told me that he never knew a steamer to be struck with lightning when her engine was at work.

8. In tropical climates there is a great advantage in iron steamers, as the internal temperature of the hold would be very much cooled by the surrounding water, which would gradually add to the health and comfort of those on board. This result was also experienced on board the iron steamer already referred to, which went to Africa. Another advantage which will be fully appreciated by those accustomed to voyages in tropical climates, is the entire freedom from insects and other animals which overrun wooden vessels, forming in frequent instances a perfect barrier to all comfort.

9. Iron steamers are less exposed to accidents than wood steamers; if the latter, for instance touches the ground but slightly and only to rub her copper, which is often the case, it is absolutely indispensable in tropical climates, to have it immediately replaced, or otherwise a few weeks will be sufficient for the worms to destroy that part of the bottom so exposed. The expense attendant even on such slight repairs, particularly in the absence of docks, would be immense. In an iron vessel, under the same circumstances, no dtfficulty would arise. Again, an iron vessel in striking a rock, would very likely suffer an indentation in her bottom, but it would not pass through the iron, when a wood plank, under similar circumstances, would, in all probability, be broken and rent. An iron vessel has been thrown on a ledge of rocks, and after beating on it for some time, was saved; it was found that the bottom was greatly bruised and indented, but still perfectly tight, and it was admitted by the spectators that a common wood vessel under similar circumstances, would certainly have bilged and gone to pieces. The iron bottom presents a perfectly smooth surface, the heads of the rivets forming a plane with the plates.

10. It is, I believe, an understood principle, that superior buoyancy makes a superior sea boat, and its application is strong proof in favor of iron vessels for steam purposes. We have the united testimony of many persons who have witnessed the operation of iron steamers in heavy weather, as to their great safety and security. It has been argued by some that this very buoyancy rendered them unfit for high sea use. This argument naturally carries one back to about twenty-five years since, when it was considered indispensable, that a vessel of three hundred tons should draw seventeen or eighteen feet of water, to enable her to hold a good wind and make her safe in a sea way. At present the American packet ships of seven to eight hundred tons, seldom draw, when in their best trim, more than thirteen feet of water.

11. It has been urged against iron steamers, that they are subject to extensive vibration by the action of the machinery. I was recently on board the Rainbow, (an iron steamboat of one hundred and ninety-eight feet length, twenty-five feet beam, and nearly of six hundred tons,) on an experimental trip from Blackwall to Gravesend and back. We had the full benefit of the tide down, and accomplished the distance in seventy-one and a half minutes, and allowing for a tide of three and a half miles per hour, we made fifteen and a half miles per hour through the water, working at a pressure of less than four pounds, with two ninety horse engines. The very slight vibration was a subject of general remark.

12. Another argument against iron steamers, is the difficulty of making them stiff. It seems very absurd to say that an iron form cannot be rendered equally stiff and firm as one of wood. An iron steamer is less likely to bend or hog than a wood steamer. The pressure is on the edge downwards, and it would be scarcely possible to produce suchan effect, unless the iron be broken, for the rivetted part may be considered equally strong as, or even stronger than the plate.

13. The construction of iron vessels can be rendered perfect only bypractice, time, and experience. The drafts or models which I have seen, admit of many improvements, but as to their eventual general adoption, we have no question. To many it appears such an innovatiou upon custom so long established, that it is condemned without cause or reason. I am perfectly persuaded that iron steam vessels can be navigated for one half the expense incurred at present in wood vessels. The opinions of the most practical and scientific men in the kingdom are universally in favor of iron as a substitute for wood in the building of steamers, both on account of its greater security, and durability, and also of its extraordinary economy.

Since the foregoing was written, I have received a report from the Seine respecting the iron steamer Aaron Mont—that she was in capital condition, very fast, and performed the voyages to the satisfaction of the proprietors; she was built in the year 1817, has run twenty-one years, and no signs of corrosion.*—*Boston Daily Advertiser and Patriot*

London, 18*th Oct.*, 1839.

SIR JAMES ANDERSON'S BOILER.

Since the invention of locomotive carriages, it has been a *desideratum* to get engines which would run along common roads, and many attempts have been made to remove the difficulty, but without success, until the recent triumph of Sir James Anderson. It has been proved by engineers that the difficulty of drawing carriages along a common road, is ten times greater than along a railroad; in other words, that the resistance is ten times greater; and a power that would drag a load of 100 tons on the railroad, could carry only 10 tons on the ordinary road. The great obstacle was to overcome this very disproportionate resistance. The world has been so long deceived by the promises of steam vehicles which could run upon common roads, that a conviction is raised of the impossibility of the attempt succeeding; but Sir James Anderson demonstrates the practicability of the undertaking, by an invention upon which he has bsen engaged for fourteen years, and which he now introduces to the public notice. This boiler resembles, externally, the figurs of a house, viewing it at its gable; the sides and roof composed of plates or chambers of water, two inches

* Drawn up by Wm. Wheelright, Esq. now engaged in introducing steam navigation from England to Chili, across the isthmus by railroad.

thick; internally, of a succession of plates same thickness, placed like partitions in a house, every partition fitting home closely to the roof, and communicating by tubes to the steam reservior at top; alternate partitions (or water plates) fitting closely to the floor or bottom of the boiler, and communicating by tubes to the general supply, or horizontal tube for admission of water; thus giving free ingress for water at bottom, and free egress for steam at top; while the fire, being placed in a space at one end, and the funnel at the opposite, a continuous flue is formed, ascending and descending alternately, until tne heat is robbed almost to its last degree, before being permitted to escape. The construction of each plate or water chamber is thus described: "They are composed of sheet iron, flat, vertical bars, two inches thick, being interposed between, at three inches asunder; and at every three inches a rivet passed through the bar and sheet; thus, over the whole surface the strongest rivets hold the sheets together at each three inches, giving a strenghth more than sufficient to resist any possible pressure from within; and the bars placed between, making it impossible (even should all the water have left the boiler, and a vacum be thus created) that it could collapse." From the resistence offered to carriages on common roads, the points to be attained in locomotive carriages for such roads, are increased strength, a size not incompatible with speed; the rapid developement of steam, and also economy of fuel. In the first place strength is obtained in the boiler now under consideration, by means of flat chambers, which possess strength, and which still fit in a boiler of a size consistent with speed. These flat chambers are each three inches long, connected with cross bars, and fixed with rivets at every three inches. They are placed in every part of the boiler, and occupy a space six feet high, six feet long, and three feet broad.

A boiler of this kind was, we understand, completed about 15 months back, and has continued to work every day since most successfully, without producing a leak or the slightest derangement; and this, notwithstanding the steam, has frequently been raised to upwards of 500 lbs. pressure upon each square inch of surface. Now the boiler contains 360 feet of working surface, which, multiplied by 144, gives 51,840 inches, and this multiplied by 500 lbs. gives the enormous pressure of 25,920,000 lbs. upon the whole boiler! A compact machine like this, which is capable of generating, sustaining, and applying so enormous a force, affords, we think, a pretty good test of the excellence of the workmanship, as well as of the principle of its construction. It is very satisfactory to have a boiler capable of resisting such a pressure; but one-tenth of it is fully adequate to all the requisites of actual practice. Then as to the rapid developement of steam—as this is made to take place from the plates being only two inches asunder, an immense quantity of steam can be produced almost instantaneously. The fire is kept up by means of a fanner worked by machinery. The air-tubes are enclosed in a cylinder of water, which water instantly condenses the waste steam, and a portion of the heat is carried on by the current of air into the fire; and at the same time, by the instantaneous condensation of the steam, all noise is absolutely removed. The incrustation that has hitherto been so fatal to bollers, is totally prevented in Sir Jame's, by the unequal heating of the water in the chambers, which causes a constant circulation of the fluid. And again: in other boilers consisting of tubes, the joints and solder are exposed to the action of the fire. In that under consideration, there is riveting without soldering, and the joints are preserved from the action of the fire by the interposition of a floor of iron. It is said that four-pense a mile will pay the cost of fuel, an expense trifling in the extreme.

Thus far we have described the construction, strength and capability of the invention; but there is one little point, without which, we might say, the whole were useless. This consists in placing perforated cones of fine wire over the orifices which admit the steam into the reservoir. At first the orifices were used without the cones, and the consequence was, that from the fact of every chamber being filled with water to the top, and coming thus within a few inches of the reservoir, the ebulition of boiling, caused a quantity of aqueous matter to be forced with the steam into the cylinders, and the engine became clogged. The difficulty was for a length of time insurmountable; but great as it was, the inventor's perseverance was greater. Reflection suggested a remedy in the application of the cones: they were adapted to the boiler, where for a period of more than eighteen months they have performed their work, untouched and uninjured, nor has the boiler all that time cost, one shilling for repairs, or been one day idle.

In consequence of having such an enormous power in the boiler as 25,920,000 lbs. pressure, the talented inventor was enabled to overcome the difficulty of ascending hills with a locomotive, in the following manner: Instead of acting directly on the axle to which the propelling wheel is attached, another wheel is set in motion, on which are a large and a small toothed wheel, the same being on the working axle: when the carriage is moving on a level, the large wheel having 24 teeth, acts on the smaller having only six; consequently one revolution of the larger wheel will produce four revolutions of the propelling axle: here power is dispensed with to increase velocity; but when the engineman approaches a hill, he can shift the steam axle, so as to bring its small toothed wheel into contact with the large toothed wheel of the propelling axle. Here the case is instantly reversed; velocity is sacrificed to acquire power; and thus Sir James Anderson has surmounted what has been previously deemed impracticable.—*Manchester Guardian.*

EXTRACT FROM A NOTICE OF THE NEW YORK GEOLOGICAL REPORT, IN THE AMERICAN REPERTORY.

"Accompanying Dr. E.'s report. is a very valuable communication of about twenty pages, from Professor Farrand N. Benedict, of the University of Vermont, giving an account of the measurements of the mountains in the northern section of the state, and some just observations as to the relative value of barometrical and trigonometrical measurements in general. According to Professor B. Mount Marcy is 5537 feet above tide water, instead of 5467, as obtained by Mr. Redfield in 1838. In relation to the comparative merrits of barometrical and angular measurements of great elevations, Prof. B. remarks as follows:

"The barometer and theodolite have their peculiar capabilities and defects; and the exact measurement with either, of a mountain covered with clouds during the greatest portion of the year, and surrounded by an atmosphere subject to incessant change, demands more perfect instruments and skill in their use than is generally apprehended.

"The chief difficulty that the barometer has to contend with, and one over which it has no direct control, is a want of uniformity in the changes of atmospheric pressure, in different places at corresponding times. As correct observations have been multiplied, more harmony in this respect has been detected than had formerly been supposed. Indeed this is not the only department in which nature has been held accountable for blunders due to clumsy instruments and unskilful observers. This difficulty, without doubt, exists to such an extent as to impair confidence in single sets of

observations at least, with whatever care they may have been made. The atmosphere, whether charged uniformly with vapor or not, must evidently have a strong tendency to equilibrium; and a derangement of it, within moderate distances, must consequently be transient. For this reason, a course of consecutive observations at the same station should always be taken, which will enable the observer to guard against error, either by rejecting all, or selecting those that in this way are shown to be worthy of confidence.

"The corrections for the hygrometrical state of the atmosphere are undoubtedly more or less imperfect, although that portion of the error which yet remains unprovided for, I apprehend, is comparatively inconsiderable. La Place measures these effects by the temperature of the air, and observes that this hypothesis very nearly satisfies the observations that have hitherto been made. The agreement of my results, where *courses* of observations were taken, intimates with what degree of approximation I have corrected for the changes of the weather. This agreement is particularly worthy of remark in relation to Long Lake, where the observations were protracted in time, and the weather singularly variable. But notwithstanding all this, I am free to admit that these corrections are still less perfect than could be desired.

"The theodolite is above the need of eulogium from any one; but, like every other human invention, it has its proper capabilities and defects. An indispensable condition to the accuracy of angular measurements is the exact determination of a base line—a work which requires that skill, variety of delicate instruments, time, and means, which in this country are not at the command of a single individual. Triangulations, embracing great extent, have been executed with astonishing precision, and the results of similar measurements, properly conducted, are entitled to the utmost confidence; on the contrary, the angular determinations of high mountains have been comparatively vague. One cause of this difference consists in the great distances at which mountains are generally observed, and the consequent smallness of the angles of elevation. In this respect a condition is almost necessarily violated, which was scrupulonsly satisfied in the surveys just referred to.

"The chief source of error in mountain measurements, and one which distinguishes it from horizontal ones, is refraction. This difficulty, growing out of the condition of the air, and independent therefore of the instrument, is analogous to the one which the barometrical method is exposed to, with this difference in favor of the latter, that the atmospheric changes going on at both stations may be detected and compared.

"Refraction differs, in different countries, and at different times, from $\frac{1}{14}$ to $\frac{1}{8}$th of the distance, reckoned in minutes. Such being the uncertainty as to the true path of light in low and familiar regions, it must be particularly difficult to follow it with precision through mediums of changing relations, and elevated tracts comparatively unknown. Refraction, too, depends not only upon the affections of the air, but upon the relations of the line of sight with other objects. Every one who has used the spirit-level, is aware of the errors that he is exposed to, when, in clear weather, his line of collimation approaches logs and fences on the surface of the ground."

To illustrate the uncertainty of the measurements of mountain elevations, Prof. B. refers to the peak of Teneriffe as an example, the height of which varies, according to geometrical measurements made by different observers, from 1700 to 2600 toises; and by barometrical observations, from 1900 to 2025 toises: thus showing that results obtained by geometrical operations, differ more from each other than those found by the barometer. It would, however, be wrong to cite this want of harmony as a proof of the uncertainty

of all measurements of mountains; for, as Humboldt in his Personal Narrative well observes, "Angles, the value of which is determined by imperfect graphometers; bases that have not been levelled, or the length of which has been determined by the log; triangles that give an excessively acute angle at the summit of the mountain; heights of the barometer, without any notice taken of the temperature of the air and of the mercury; unquestionably are not means calculated to lead to accurate results."

Prof. B. suggests a connection of the Saranac river which empties into Lake Champlain at Plattsburgh, with Racket river, which empties into the St. Lawreuce, near St Regis. From his calculations, it appears that by excavations equal in the aggregate to $6\frac{1}{2}$ miles, and an amount of 240 feet lockage, continuous lines of batteaux navigation through, and connecting these two rivers, may be formed, equal in extent to 210 miles; and that this would be increased to more than three hundred, if we take into consideration the coasts of the lakes.

THE ELECTRO MAGNETIC TELEGRAPH OF THE GREAT WESTERN RAILWAY.

This telegraph, which is the useful and scientific inventifin of Mr. Cooke and Professor Whitestone, of King's college, has been, during two months, constantly worked at the passing of every train between Drayton, Hanwell, and Paddington. At the former station it, for the present, terminates. As soon as the whole line is completed, the telegraph will extend from the Paddington terminus to Bristol, and it is contemplated that information, of any nature, will then be conveyed to Bristol, and an answer received in town in about twenty minutes. Merchants and others, residing not only at the two extremities of the line, but at any of the intermediate stations (at all of which dial plates will be fixed, with competent persons stationed to work the telegraph), will then be enabled to avail themselves of the benefits and facilities of Messrs. Cooke and Wheatstone's invention. Two of the boys from the deaf and dumb assylum in the Kent road, have been at the Paddington station for five or six weeks, where they were instructed in the working of the machinery by Mr. R. Hutchison, and they are now perfectly competent to snperintend the telegraph at any one of the stations. A piece of machinery, simple but unerring, to which is attached a check-string to indicate to the boys when the signal is sent up to the line to show that something is about to be telegraphed, has been invented by Mr. Cooke, which enables these lads to perform this duty as efficiently as if they were not suffering under the deprivation of hearing and speech. The telegraph has now been in operation for nearly twelve months, and not the least obstruction to its working, by any of the wires, &c., becoming out of order, has yet occurred. Should such an event take place (especially when the whole line is open to Bristol), it might occur to many that there would be considerable difficulty (as all the wires are enclosed in a hollow tube, not more than about an inch in diameter) in ascertaining, throughout the 117 miles, the precise point at which the injury required to be repaired; but this apparent difficulty has been met by Mr. Cooke, who has invented a piece of mechanism which is contained in a mahogany case, not more than eight inches square, by which means the precise spot on the line where the injury might have been occasioned, would be indicated in an almost incredibly short space of time. The invention may now by termed perfect in all its details, and only awaits the completion of the line of railway to Brtstol to bring it into full operation between that city and the metropolis.—*Mining Journal.*

For the American Railroad Journal and Mechanics' Magazine.
METEOROLOGICAL RECORD FOR THE MONTHS OF MARCH and APRIL 1840
Kept on Red River below Alexandria La. (*Lat* 31.10 *N. Long.* 91.59 *W*)

1840	Thermometer.					
May	Morn.	Noon.	Night.	Wind.	Weath.	REMARKS.
1	74	82	81	SW	clear	heavy thunder N to NE no rain
2	76	86	82	SW high	..	
4	76	87	82	SW light	..	
4	74	87	80	calm	..	foggy morning
5	70	84	70	..	..	heavy clouds in the NW
6	74	86	81	S	cloudy	light showers in the morning
7	78	80	77	SW	..	light showers all day, heavy thunder NE
8	72	88	86	..	clear	lightning in the SE all night
9	62	61	58	N	cloudy	
10	58	68	67	..	clear	
11	60	71	70	SE	..	Red river over its banks and rising fast
12	62	72	67	..	cloudy	
13	64	73	71	S	clear	
14	62	76	70	..	cloudy	thunder shower in the evening.
15	66	76	73	..	clear	thunder in the west, no rain.
16	68	80	72	..	..	
17	68	78	76	..	..	light shower in the evening
18	71	81	78	SE	cloudy	Red river continues rising
19	73	84	78	calm	clear	
20	72	82	75	N	..	
21	66	80	74	calm	clear	
22	66	80	74	..	..	
23	70	80	76	..	cloudy	
24	70	82	72	..	clear	evening light shower form NW
25	70	81	72	..	cloudy	showers all the forenoon
26	66	76	72	..	clear	
27	68	80	75	..	..	
28	70	83	76	..	..	
29	71	81	75	N	..	
30	74	83	75	calm	..	Red river still rising.
31	73	82	74	..	..	up to high water mark
	69	80	74	....	....	mean temp. of the month 74.3
June						
1	72	88	81	SW	clear	
2	72	88	83	W	..	
3	74	88	82	..	..	Red river at a stand, at its highest water mark
4	75	90	85	calm	..	smoky hasey atmosphere
5	76	91	88	S	..	
6	72	82	79	calm	..	Red river commenced falling
7	70	77	74	NW	..	in the morning a gale from W to N heavy thun- [der balance calm and clear
8	65	76	75	..	..	
9	66	81	78	calm	..	
10	74	80	71	E	cloudy	
11	70	80	78	calm	clear	
12	72	84	82	SE	..	afternoon heavy thunder—no rain
13	74	85	78	calm	..	
14	75	85	84	..	..	
15	75	85	80	SE	..	Red river fallen one foot—and within its banks
16	73	84	78	..	..	
17	75	80	80	calm	cloudy	
18	74	77	74	..	..	rain light all night
19	72	75	73	..	..	morning light showers heavy rain afternoon
20	72	75	78	..	..	light showers [and evening showers all night
21	75	82	86	..	clear	morning and evening clear
22	74	78	77	..	cloudy	evening thunder shower
23	76	80	78	SE	..	showers all day
24	77	87	83	S	clear	light showers afternoon
25	80	86	82	SW	..	
26	76	88	84	SE	..	
27	76	80	86	..	..	
28	76	92	86	S	..	
29	77	90	86	..	..	
30	77	91	86	..	..	
	74	84	80	....	....	mean temp. of the month 79.

Use of the Walnut Tree.—Walnuts yield half their own weight in oil, whose flavor is considered to equal that of the finest Lucea oil. This very fruitful tree, which we see flourishing along the high road, and in the orchards of peasants, is one of great utility to the German : his furniture is made of it; the leaves dye a good black; and he feeds his cattle on the shells of the nuts that have supplied his oil,

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 4, Vol. V. New Series.	AUGUST 15, 1840.	Whole No. 364 Vol. XI.

We herewith present to our readers the first communication of Mr. Klein, whom we before announced as a regular contributor to the Railroad Journal.

We have before given to our readers, ample details of the St. Petersburg and Zarskoe Selo railroad, and we are now enabled to complete the statistics to the commencement of the present year. There are many interesting deductions to be drawn from these details; and the completeness of the information, and its methodical arrangement, may serve as a model in preparing the statistics of our own railroads.

For the American Railroad Journal and Mechanics' Magazine.

ST. PETERSBURG AND ZARSKOE—SELO RAILROAD.—ITS OPERATIONS IN THE YEAR 1839.

There are few railroads in Europe the progress and success of which have been watched with so mnch interest as that of the St. Petersburg and Zarskoe Selo railroad. Although one of the shortest lines of improvements of this kind, the peculiar circumstances under which it was projected and commenced; the manner of construction itself, and finally its important influence upon the whole system of railroads to be introduced sooner or latter in the vast Russian empire, were motives enough to engage the attention of all friends of internal improvements.

A report of the late Chavalier de Gerstner,* on this railroad, was published in English three years ago; in this report an account was given of the location of the road, its grades, and plan of construction, and the progress it had made up to the winter of 1837. In the summar following, the remainder of the works were finished, and the railway opened to Zarskoe

* See first Russian Railroad from St Petersburg to Zarskoe Selo and Pawlowsk; &c translated from the German. St Petersburg, 1837.

Selo, a distance of 15 miles, on the 30th of October 1837. The continuation to Pawlowsk, 2 miles further, though completed soon after, was not opened until May 1838. Since that time the whole line has been in operation, without interruption through all seasons of the year, and to the general satisfaction of the public, the trains have daily been running over the road with the greatest precision and regularity; thus proving what, until lately was thought problematic—that railways may be constructed and used to as much advantage in Russia as in any other part of the globe.

The following short statistics of the Zarskoe Selo railroad will spare the reference to the Chev de Gerstner's report. Totol length of the railroad 25¼ versts, or 17 English miles. No curves, except at the St. Petersburg terminus. Total ascent from St. Petersburg to Pawlowsk 87 feet, average rise, 5 feet to a mile, steepest grade 10½ feet to a mile. Track single; width of the same: six feet clear; superstructure: wooden cross ties, upon a stone foundation, supporting heavy T rails of 65 lbs per yard, fastened in chairs every 3 feet.

Number of locomotive engines on the road, six; diameter of cylinders, 14 inches; stroke 18 inches; diameter of driving wheels, 6 feet; weight 14 tons.

From the report lately made by the directors of the company to the shareholders at their last annual meeting, the following statements have been carefully extracted, and will, with the conclusions drawn from them give a clear insight into the operation and management of the road during the year 1839.

1. *Cost of construction.*—The total cost of the road up to the end of 1839 was 1,503,823.50 rubles in silver, and consists in the following principle items:

Construction of the road itself, - -	676,450.47	S. R.
Buildings of every kind, - - -	301,421.68	—
Locomotives, cars, &c., - - - - -	259,050.89	—
Engineering, and all other incident expenses,	266,900.46	—
Total expenditure, - -	1,503,823.50	—

or 228,740 liv. st., or 1,110,000 dollars. Of this amount 1,000,000 rubles were paid in by the shareholders, and 500,000 rubles were loaned to the company, by the government, at 5 per cent. interest and one per cent sinking fund.

The cost of the road per mile, is therefere 13,455 liv. st., or 65,300 dollars.

2. *Number of passengers; receipts.*—The following table contains the number of passengers conveyed monthly over the road between the different places; as also the receipts from passengers, as well as from other sources:

MONTHTS. 1839	NUMBER OF PASSENGERS CONVEYED.				RECEIPTS FOR THE WHOLE YEAR.		
	Between St. Petersburg and Zarskoe—Selo.	Between St Petersburg and Pawlo'sk	Way passengers	Total	From passengers	From other sources	Total
					DOLLARS	DOLL'RS	DOLLARS
January,	25,055	6,744	5,060	36,859	10,280	510	10,790
February,	23,441	5,538	4,231	33,210	9,818	347	10,165
March,	25,601	5,418	4,344	35,363	10,543	295	10,768
April,	29.608	9,585	5,171	44,364	13,531	155	13,686
May,	66,013	7,154	20,980	94,147	24,583	265	24,848
June,	68,848	2,103.	25,334	96,285	22,799	530	23,329
July,	65,608	15,50	28,264	95,422	22,596	347	22,943
August,	67,033	——	25,574	92,607	22,874	482	23,356
September	56,429	84	14,744	71,257	18,154	395	18,549
October,	50,681	22	8,745	59,448	14,632	2635	17,267
November	30,707	3,025	4,778	38,510	10,499	452	10,951
December	22,480	1,632	4,042	28,154	7,987	690	8,677
Whole year,	531,504	42,855	151,267	725,626	188,296	7,033	195,329

From this statement it appears, that the total number of passengers which travelled on the Zarskoe Selo railroad, in 1839, was 725,626; if reduced to the whole length of the road, we find the number equal to, 521,882 through passengers.

The population of St. Petersburg is now		470,000
"	of Zarskoe Selo, - -	11,400
"	of Pawlowsk, - - -	4,100
Total population on the line of the railroad,		485,500 or

36,382 less than the number of passengers which travelled over the whole road during one year. If the number of through passengers (521,882) be compared with the total passage money, it gives at an average per passenger for 17 miles, 49 copeks silver, or 36 cents; or per passenger per mile. only $2\frac{1}{8}$ cents.

If the total receipts for the year be divided by the length of the road in miles (17) it gives 11,490 dollars gross income per mile of road, per year, which compared with the cost of the road per mile (65,300 dollars) shows that the gross receipts per year amounted to $17\frac{6}{10}$ *per cent on the cost of construction.*

3. *Travel of locomotive engines. Speed.*—The following shows the monthly returns of the trips made by the locomotive engines upon the road:

MONTHS. 1839	Number of trips with passengers	Duration of trip betwe'n St Petersburg, and Zarskoe Selo		Average speed	Numbes of miles travelled by all locomotives	Average rec't per mile of travel
		shortest	average			
		MINUTES	MINUTES	MILES		
Jauuary,	213	30	42.9	21	5,333	202 cents
February,	301	30	42.5	21	5,233	194 —
March,	310	32	40.6	22	5,167	208 —
April,	327	30	40	22½	5,667	241 —
May,	528	25	43.7	20½	9,433	263 —
June,	609	31	39	23	10,200	229 —
July,	609	30	38.2	23½	10,150	226 —
August,	578	26	39.3	23	9,617	243 —
September	480	25	39.5	23	8,167	227 —
October,	442	27	39.8	22½	7 583	228 —
November	293	31	40.6	22	5,000	219 —
December,	301	33	42.2	21½	5,033	172 —
12 m'nths	5,091	25	40.8	22	86,583	226 —

There have been made during the year, 5091 trips over the whole road, equal to 7 trips each way per day; the average time spent on a trip between St. Petersburg and Zarskoe Selo (15 miles,) including one stoppage haif way, was 40.8 minutes, which gives an average speed of 22 miles per hour; the shortest time spent on one trip was 25 minutes, corresponding to a speed of 36 miles per hour.

The number of miles, run by six locomotives during 12 months were 86,583, being at an average 14,430 miles by each engine. One of the engines, the "Elephant," has run only 2,567 miles, which leaves for each of the remainder, 16,803 miles, at an average.

The number of carriages used for the 5091 trips (counting a carriage once for each trip) was 27,333; and the number of through possengers carried therein, as before stated, 521,882; this makes at an average, per trip, 5⅓ carriages, and 102½ passengers, or per carriage 19 passengers. The carriages are of 4 different classes, all fourwheeled, and contain each from 24 to 60 seats for passengers.

In the last column of the above table is contained the average receipts per mile of travel of the locomotives, with their trains in every month of the year. It demonstrates the fact that the income per mile of travel is always greatest, when the traffic on the road is large, as then the number of passengers per trip will average more, while with a small traffic the trains will frequently be half empty, and the receipts per mile proportionally small.

4. *Current Expenses, Net Revenue.* The following were the expenses of managing the railroad during the year ending 31st December, 1839, divided under the different heads.

a) Maintenance of Road and buildings:		
Maintenance of the road itself, ground rent,	$	$
bridges, turnouts, road crossings. &c., -	11,490	
watchmen and police, - - - - -	8,806	
Maintenance of buildings, insurance, heating, and lighting, . - - - -	10,356	
	———	30,652
b) Transportation Account:		
Motive power, repairs of engines, engine and firemen's wages, pumping water, fuel, oil, hemp, &c. - - - - - -	34,440	
Repairs of cars, oil, &c., - - - - -	7,452	
Wages, and clothing of conductors, agents, -	9,719	
	———	51,611
c) General Expenses:		
Wages of superintendents and officers, rent, police, discount, stationary, &c. - - -	17,281	
Pensions and indemnities to persons injured upon the road, - - - - - - -	1,867	
	———	19,148
d) Expenses for Entertainments:		
Music, illuminations, fireworks, - -	26,297	
Other incidental expenses, - - -	6,778	
	———	33,075
Total Expenditure, - - - -		$134,486

The total gross receipts having been 195,329 dollars, the net income amounted to 60,845 dollars, or to 31 per cent. of the gross receipts, or to $5\frac{1}{2}$ per cent. on the capital of construction.

To have a clearer view of the expenses connected with the railroad itself, the latter sum of 33,075 dollars, expended for the entertainment of the public ought not to be taken into account. It has been ascertained that the income derived by these extra expenses is only sufficient to cover these expenses, and, therefore, has no influence upon the net revenue. To be enabled, therefore, better to compare the results of the Zarskoe Selo rail-with those of other roads, the sum of 33,075 dollars must be deducted both from the gross receipts and current expeuses: we then have:

Current Expenses:	*dolls.*				*cts.*
For maintenance of way, &c.	30,652, being per mile of travel				35.4
" transportation account,	51,611	-	-	-	59.5
" general expenses, -	19,148	"	"	"	22.1
Nett income, - - -	60,843	"	"	"	70.0
Gross receipts	162,254	"	"	"	187

The nett proceeds are now 37 per cent of the gross revenue; the expenses 63 per cent. The expenses per mile of travel of a locommotive with a train of cars are 117 cents, and are obtained by dividing the total current expenses with the number of miles travelled by all engines during the whole year. If we compare the expenses per mile of travel (117 cents) with the average number of through passengers in a train ($102\frac{1}{2}$) or also the total current expenses ($101,411) with the number of passengers reduced to one mile, which is $521,882 \times 17 = 8,871,994$ we find the expense per passenger per mile, equal to 1.14 cents.

It may be of interest to consider more minutely some of the items of expenditure, we then see the expenses of maintaining and watching the road are equal to 1194 dollars per mile of railroad per year. This amount is very considerable, and the cause of it to be found in the great number of hands employed constantly along the line for the purpose both of watching the road and keeping the rails in the proper level.

The expenses for motive power comprise the following items:

Repairs of engines	$4884	per mile	of travel,		5.64	cents.
Pumping water, -	775	"	"	"	0.90	—
Fuel (coke) - -	20,081	"	"	"	23.19	—
Oil and tallow, hemp,	1,804	"	"	"	2.08	—
Engineers and firemen	6896	"	"	"	7.96	—
	——	"	"	"	——	
Total, - -	$34,440	"	"	"	39.77	—

The motive power costs forty cents for every mile the engines run, only the seventh part of this expense is for repairs of the engines. The fuel alone costs 23 cents per mile. Upon the American railroads with moderate grades, the engines drawing passenger trains, consume at an average, 1 cord or 128 cubic feet of hard wood for every 40 miles they run. The price of the wood varies from 2 to 6 dollars, including sawing, splitting, &c. In St. Petersburg, the price of birch wood will be about $4\frac{1}{2}$ dollars per cord of 128 cubic feet; and if we again allow 40 miles for one cord, we have as the expense of fuel per mile of travel, $\frac{450}{40}$ cents, $= 11\frac{1}{4}$ cents, or one half of the present expense for coke. The reason why wood is not used as fuel for the engines upon the St. Petersburg railroad, is the want of an effective spark catcher, by which the throwing out of sparks through the chimney might be entirely prevented.

In regard to the whole operation of the road, the results may be considered as very satisfactory. Although constructed at an expense of $63,000 per mile, and passengers are carried at such low rates, the railroad nevertheless yields an annual interest of $5\frac{1}{2}$ per cent. on the capital invested.

As the company has to pay 6 per cent. on the loans, as interest and sinking fund, the dividend paid to the shareholders for the year 1839 was only 4 per cent.

L. Klein.

London, June, 1840.

To the Editors of the Railroad Journal and Mechanics' Magazine.

REMARKS UPON THE EXPLOSION OF THE LOCOMOTIVE UPON THE HARLEM RAILROAD,—July 4th, 1839.

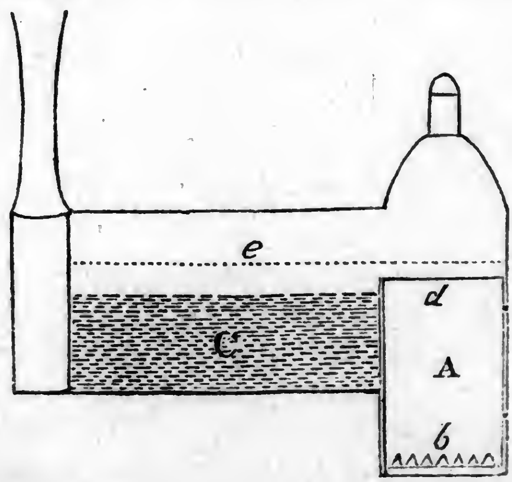
Supposing the readers of the Journal may be desirous of learning more of the particulars relative to the explosion of the locomotive upon the Harlem railroad, on the 4th of July 1839, than appeared at the time in the public prints, I give them to you as near as I could gather them on the ground soon after the accident occurred, together with my views of the cause.

The engine was nearly new, constructed in most respects on the most approved plan, for a six wheeled engine, and had run but little over a year. It is not reasonable to suppose therefore, that the accident was owing *altogether* to a defect in the engine. At the time of the explosion, I was not far distant, being on my way to take my seat in the cars which were to be conveyed to Harlem, by the engine in question,—of course as but a few minutes had elapsed between the explosion and my arrival on the ground, the fragments of the engine &c. occupied very nearly the several positions into which they were thrown by the explosion.

At the time of the accident there was no train attached. The train from Harlem had just been brought down, and passed on with horses to the City Hall, and the *up* train had not arrived, though not far distant.

In reversing the direction of the engine for the purpose of returning to Harlem, which was done by passing it on to the eastermost track by means of a turn out,—the forward or truck wheels, owing to a defect in the *switch*, got off from the track. The superintendent with the assistance of some others, including the Engineer, set immediately at work to replace the engine on the track, and when they had nearly accomplished their object, the explosion took place. killing instantly the engineer, tearing and mangling his body in a most horrid manner, and injuring more or less severely several others.

On examining the boiler, I discovered that the roof of the fire-box was completely blown out, carrying with it the grate and bottom of the fire-box, with all the fuel it contained. To render the explanation the more clear I present a sketch as follows:—



A is the fire-box, *b* the grate, C the tubes, *d* the roof of the fire-box, and *e* the level of the water in the boiler when filled.

In the explosion the iron plate forming the roof *d* of the fire-box, gave way, *downward* carrying with it the grate, fuel, &c. The reaction was so great as to cause the engine to plunge suddenly forward, the rear part being forced up obliquely; the engine was thrown upon its side, separating it of course from the tender.

The injury to the engine was produced mainly by the force with which it was thrown over, breaking the shaft of the driving wheels, the journals of two or three of the others, the cylinders, and most of the working gear. The boiler did not appear to be much injured, save in the parts mentioned; and the reason of the Engineer being so badly mangled must have beeu owing to his standing in such a position as to receive most of the contents of the fire-box.

The cause of the explosion I suppose to have been simply this: more time was probably occupied in getting the engine on to the track than was imagined. In the mean while the fire was not extinguished, and the engine not being in motion, the force pump was not in operation, the water fell in the boiler, and became so low as to expose or uncover the roof of the fire-box, which soon becoming heated gave way under the force of the steam from above.

I have seen no published explanation of the cause, or of the appearance of the boiler and engine, after the explosion; but I feel confident that I am not far from correct in the view I have taken.

It has always appeared to me that the roof of the fire-box of a locomotive, was the part most liable to give way under a diminution of water in the boiler. It is higher than the tubes, and would be first exposed. It receives also the direct vertical action of the heat, and when once uncovered, must become red hot in a very few moments; and being a *horizontal* plate three feet square, or thereabouts, would, unless made very thick and strong, and supported by iron ribs, soon give way under pressure.

The roof of the fire-box in question was supported in this manner, there being about seven bars of $1\frac{1}{2}$ by two inch wrought iron extending across and firmly riveted to the plate of the roof. Unfortunately these bars, instead of extending *quite* across and having a firm bearing upon the upright portions of the fire-box, fell short about $\frac{3}{4}$ths of an inch. This certainly was a defect in the construction. In all other respects, the engine appeared to be well made. Notwithstanding this defect, the roof would not probably have given way, had not the water been too low and the iron become heated.

That this occurs oftener in engines than is generally imagined, I do not doubt. Engines may be pointed out on several roads, where the roofs of the fire-box have been forced down by the superincumbent pressure so as to form quite a concavity. In one instance, the concavity has been observed large enough to contain full one gallon. This could only, I think, have been produced by the roof of the fire-box, having at same time been unco-

vered sufficiently long, to have become somewhat heated, and thereby weakened. It is, perhaps, almost needless to state that should they be permitted to remain in this situation long, while the fires are burning briskly, an explosion would be the inevitable consequence.

The above is, I believe, the second instance of an explosion of a locomotive, where the consequences were at all serious; the first having occurred about a year previous on the Rainhill plane of the Liverpool and Manchester railroad. Within the past year a third instance is stated to have occurred on some one of the roads in the U. S., the particulars of which, if made public, have never met my eye.

FULTON.

NOTICE OF SOME EXAGGERATED STATEMENTS IN REGARD TO THE VACUUM MAINTAINED IN THE CONDENSERS OF THE BRITISH QUEEN, AND OTHER ENGLISH STEAMERS.—HALL'S CONDENSERS.

Many of our readers no doubt were surprised, as we ourselves were at the statement that the guage attached to the condensers of the British Queen, indicated a steady vacuum of $30\frac{1}{2}$ inches, during the trip out in April last. When it is recollected that the average pressure of the atmosphere, supports at the level of the sea but 30 inches of mercury, the inquiry very naturally suggests itself,--how can a vacuum be obtained which is not only perfect, but carries with it a minus pressure or subtractive force of $\frac{1}{4}$ of a pound per square inch?

In endeavoring to solve this question, we fortunately found in the same number of the Mechanic's Magazine, with the log of the "British Queen" a drawing of "Bedwell's patent steam engine barometer," by which this extraordinary vacuum was registered. A mere inspection of the drawing is sufficient to explain a little more than the surplus above a perfect vacuum, and in the condensers themselves we may perchance find a cause for further reduction. Were this not the case, we should have in Hall's condensers a more complete instrument than the most highly finished air pump—*notwithstanding* the *pressure of aqueous vapor*--a manifest absurdity.

In the first place "Bedwell's barometer" is no more than an ordinary air pressure gauge—with this exception, that instead of the open leg of the cyphon, is found a bulb open at top, and which contains the mercury as it descends in the closed end. An exact coincidence in the two limbs—indicatting a perfect vacuum—is marked three inches, and above this the scale is laid off by inches decreasing to about 25. Now it is evident that the assumption of 31 inches is gratuitous, and likely to cause erroneous estimates to be made.

A much safer and better mode of graduating would be to commence with zero for a perfect vacuum, and to number the inches 1, 2, 3, &c., upwards, which would give at once the resistance of the air and vapor included in the condenser. Thus in the case above mentioned, instead of $30\frac{1}{2}$ inches

vacuum, (a round about way of denoting it, to say the least) we should have an atmosphere supporting $\frac{1}{2}$ an inch or a pressure of $\frac{1}{4}$ of a pound per square inch to be deducted from the effective pressure.

From some remarks in a communication on this subject in the Mechanics' Magazine, we are led to suppose that the instrument in question could not have been in order and the slightest portion of vapor or air in the closed end would of course tend to vitiate all its indications.

It may also be observed that there is an exaggeration in stating that the guage stood *steadily* at $30\frac{1}{2}$ inches as on the very day the certificate to this effect wss signed, and for several days preceeding the vaccum, as given in the published log, was not so great. In fact $30\frac{1}{2}$ inches are recorded only on five days out of the fourteen.

Another objection urged by several writers, and one which we consider as having some weight, is, that the condenser on Hall's plan, is exceedingly complicated, in its passages, and that the vacuum indicated by the gauge, exists at a point comparatively speaking, quite remote, from the cylinder, and is therefore, no more an indication of the useful vacuum, than the pressure in the boiler is a measure of the useful pressure in the cylinder. When it is remembered that in each of the condensers of the "British Queen," the steam passes through *seven miles* of $\frac{1}{2}$ inch pipe, it is easy to see that an instantaneous effect cannot be produced throughout the apparatus.

We have been favorably impressed with the advantages offered by Hall's condensers, but we must confess that we fear that they cost as much as they are worth, if not a little more. The immensity of this apparatus in the "British Queen," quite startled us, and we could not upon reflection, reconcile this with our ideas of economy in size and weight. The question is between the increased vacuum (?), the clean boilers, and consequent saving of fuel on the one side, and the increased cost and weight, and the loss of room on the other.

We give a table of the dimensions of the machinery of the "British Queen," and "India," by which it seems that the space occupied by this apparatus is nearly equal to that of a good sized steam engine itself.

	British Queen, 500 *h. p.*	*India* 350 *h. p.*
Diameter of Cylinder,	$77\frac{1}{2}$ inches	63 inches
Hall's condensers, each,	$77\frac{1}{2}$ inches square and 12 feet high	63 do. exact shape and size of cylinder. 7 feet 1 inch high
Miles of half inch pipes in the two condensers	14*	9
No. of joints in ditto,	14,000*	9,000
Two extra force pumps to supply the condensers,	area $22\frac{1}{2}$ by $17\frac{1}{2}$ and 3 ft. 8 stroke	area 18 in. diameter stroke 3 ft. 10 in.
Revolutions,	$14\frac{1}{2}$ and 18 when light	not given
Vacuum,	$30\frac{1}{2}$	$29\frac{1}{2}$
Stroke	7 feet	5 feet 9

* No mistake, I assure you—fourteen miles of pipes, and fourteen thousand joints. Nice employment for the engineers to keep joints tight when they have nothing else to do; and no fear of derangement from expansion and contraction, which at 15 revolutions a minute takes place alternately every second!

We are much obliged to our correspondent Fulton, for the sensible description of a disaster which excited much attention, and yet has never, so far as we have known, been properly explained. How much better would it be on the occurrence of this or other accidents of the kind, for some intelligent person to examine immediately into the matter, than to indulge in the newspaper twaddle usual on such occasions.

Coach wheel retarder.—Full trial has now been made of the valuable invention of R. W. Gearrad, Jun. Esq. for retarding,(not locking) the wheels of carriages when going down hill. Mr. Dangerfield, coach proprietor, having had it applied first to one of his Southampton coaches, and afterwards to the Shrewsbury coach, and in both cases with the greatest success. The principle of the invention, is pressure, so applied to the nave of the wheel, as to retard its motion, or at will of the coachman, stop it altogether. The advantages of the invention are, that the power may be applied at tne discretion of the coachman.

Frauds in soap.—With regard to silica and clay soap, the experiments which have been hitherto made are not sufficiently numerous to give the requisite information; but as neither the silica nor the clay contributes anything to the detergent qualities of the soap, but merely increase its weight, all such additions should be prohibited by government. Suppose a pound of good soap to cost 6d., and that another soap containing 20 per cent of silicia or clay, is sold at 4¾d., the two will be exactly the same value, for four pounds of the good soap will go as far as five pounds of the adulterated soap. If the manufacturer charges 5d. for the pound of the adulterated article, he overreaches his customers to the extent of a farthing per pound. If this apparent cheapness have a tendency to increase the sale of soap, it operates as a premium to induce manufacturers in general to adulterate the article. The great extent to which the trade of Great Britain has reached was originally founded on the goodness of the article manufactured; the present rage for cheapness has an universal tendency to adulterate, every article exposed for sale; and unless it is counteracted by a vigilant government, it must terminate in the destruction of the foreign trade of the country. The soap made for transportation is always of inferior quality; hence the monopoly of the French soap-makers, who supply Italy, Spain, and South America with all the soap required by those extensive countries. If silica soap be permttied to be made, it ought to be charged according to its specific gravity, allowing it to contain 20 per cent of silica, as the maker supposes it to do. Hence its specific gravity in the liquid state ought to be 1.3191. Hence a pound of it will have the bulk of 21.016 cubic inches; or it ought to pay one-fourth more duty than common yellow saop. In what is called clay soap, the clay is not at all combined with the alkali, no soap is formed with it; and its action is merely mechanical; in fact it diminishes the power of the soap with which it is mixed in proportion to the quantity. The motives for mixing clay with soap are too obvious and too well understood, to require any comment.—*Report of Commissioners of Excise.*

The opening of the Taunton and New Bedford railroad took place July 1st, and went off Admirably. The governor of Massachusetts, and a large number of citizens attended. The Boston Adv. says:

On their return one of the trains ran over the N. Bedford and Taunton road, 20 miles, in 38 minutes and another in 35. The Taunton branch of 11 miles was passed by the returning party in 22 minutes, and the portion of the Providence road, 24 miles, which makes a part of the route to New Bedford, was passed in 49 minutes.

For the American Railroad Journal and Mechanics' Magazine.

A SYNOPSIS OF BIONOLOGY. BY OLIVER SMITH.

ZOOLOGY. Of the *animals* the tisue contains a full proportion of Nitrogen.

- Of the *Articulated* animals the tisue is very muscular.
  - Of the *Vertebrates*, or the animals which have bones, the tisue is very fibrous.
    - Pulmonates
      - Bicordates
        - Of the Mazons the tisue is carnate.
          - *Antrope* or Anthropos, man
          - *Geomazons*, the terester mazons
          - *Hydromazons*, the aquatic ones
        - Of the *Ornithies*, or fowls the tisue is suigenery, though it is somewhat carnate about the neck.
      - Of the Reptiles the tisue is carnate.
        - Panoplerpons
          - Poderpons
            - *Testudinies*, turtles
            - *Saurocopies*, ichthiosaurus
            - *Sauries*, lizards
          - Lepiderpons
            - *Saurophies*, Ophisaurus
            - *Ophies*, proper serpents
        - Gymnerpons
          - *Pedonerpies*, frogs
          - *Branchiaterpies*, sirens
    - Of the Ichthies the tisue is suigenery.
      - Ichtheosties
        - *Malacopters*, salmon
        - *Acanthopters*, perches
      - Icthechonders or *Chondropters*, sharks
  - Of the *Entomies* the tisue is much indurated externally; while it is celular and full of fluids within,
    - Entomobranchiates.
      - *Entomapodes*, leeches
      - Entomoplies
        - *Crustates*, crabs
        - *Entomostracas*, horse-foot
    - Entomotracheates
      - Octopodes
        - *Entomopsiles*, spiders
        - *Entomateles*, ticks
      - Orthotracheates
        - Hexapodes
          - Entomopters
            - Tessaropters
              - Stegopters
                - Maxilates
                  - *Stegomacters*, coleopters or horn bug
                  - *Stegodermas*, cock-roaches
                  - *Stegodomos*, grass-hoppers
                - Haustelates
                  - *Stegomipters*, bed-bugs
                  - *Stegomopters*, cicadas
              - Hyperopters
                - Maxilates
                  - *Trichopters*, larvas in water
                  - *Nomoneuropters*, libelulas
                  - *Terrebrifers*, tenthredoes
                  - *Aculeifers*, bees
                - Maxilohaustelates or *Leipodopters*, butterflies
            - Entomodipters
              - *Strephopters*, kirbies,
              - *Librators*, flies
          - *Hexapodapters*, fleas
        - *Myriapodes*, centipedes
- Of the *Moluscate* animals: the tisue is soft, and many of them have a calcian habitation.
  - *Zoacephalics* or headless animals. Chitonomics.
    - *Hetropodes*, carinaries
    - *Cephalopodes*, cuttle-fish
    - *Gastropodes*, slugs
    - *Conchophors*, snails
  - Nor[illegible]pitates. Tunickecapitates.
    - *Cirropodes*, balanies
    - *Valvifers*, clams
    - *Spermazoas*, resembling seeds
    - *Polyzoas*, associated but not compound
      - Tunicates of authors
      - Small & floating
    - *Siphonics*, holothurias
    - Discates
      - *Dermecheinies*, star-fish
      - *Medusas*, Portuguese man of war
    - Elminthies
      - *Exolminthies*, worms living on the exterior of other animals.
      - *Endolminthies*, worms living in the interior of other animals.

The Zoophites exhibit both an animal and vegetable character.	The Infusorties appear in warm water which contains animal or vegetable matter.	Phytanomics (see Botany, upon the next page.)
Crinoidophors, *Stomanthics*, *Fistulifers*, *Rupifers*, *Fruticulifers*, *Spongifers*, *Plumulifers*, *Vaginifers*, *Podostomas*, *Hetrozoas*	*Animalculus*	*Yeastas* or common yeast, *Fungues*, *Algas*, *Lichens*

The Biomycetes are entirely celular and contain only a moderate portion of nitrogen.

BIONOLOGY—(see upon the next page)

A SYNOPSIS OF BIONOLOGY.

(*Continued*,)

The Vascular plants have spiral vessels within them; and their tisue assumes, to a greater or less extent the form of ligneous fibre.

The Flowering plants bear flowers and exhibit considerable ligenous fibre

The Exogenous plants increase by addition to their outside; they consist much of ligneous fibre; their seeds are dicotyledinous and their leaves for the most part are annually deciduous.

Of the Spermendytics the ovary is normal, inclosing the seeds at their incipience at least.

Ecorolates:

Ecalycates:

Spadexogenas, pepper
Spathexogenas, podostema
Ovarinaments, birch
Nomacalycates, all the rest

Calycates:

Nucemoschifers, nutmeg
Juglandifers, walnut
Depatocarpics, oak
Artocarpics, fig
Spermagonics, buck-wheat
Corticaromas. sassafras
Nomastephanics, all the rest

Corolates:

Petalates:

Orangifers, orange
Pomifers, apples
Plumbifers, plum
Vinifers, grapes
Rizophors, see natural order
Parenchymates, cactus
Umbelifers, dill
Leguminifers, beans
Siliquifers, mustard
Rosates, rose
Magnolians, white wood
Malvates, mallows
Bombacates, bombax
Linins, flax
Nympheans, pond lily
Violates, violets
Nomexogenas, all the rest

Of the Corolintegers, the petals of the coral are connected together & many of them are herban and frutican.

Peponifers, punkin
Composites, sun-flower
Campanulates, add convolvulates
Stylidates, natural order
Stellates, madder
Normalabiates, all the irregulars
Nomolostephanics, all the rest.

Of the Spermagymnics the ovary which is a mere scale or contracted leaf never encloses the seeds; and the texture of their ligneous fibre is somewhat peculiar.

Pinins,
Juniperins,
Zamians,

The Endogenous plants increase by additions to their interior parts. They are seldom much ligenous compared with the higher grades of plants, and their seeds are monocotyledinous

Spadicoidates, palms, muses
Stephanecalycates, lilies
Nomendogenas calyce & coral
Spadicates, spadica proper
Glumifers or calyce glumate: *Bambutes*, *Graminates*, *Cyperates*,

The Subvascular plants have but few spiral vessels, & but little ligneous fibre within them; and they are mostly Acrogenous increasing but little in diameter after they commence to grow.

Ferns: ——— tropical ferns; *Filices* common ferns; *Botrics* differ a little
Licopodes, ground pine
Equisetes, scouring rush
Marsilas, small aquatics

The Celular plants consist of celules and they are mostly Acrogenous increasing but little in diameter after they begin to grow.

Mosses, well known
Hepatics, liverwort
Caras, small aquatics

BOTANY.

Of the Vegetals proper the analysis shows but little nitrogen, and often none at all. Their ligneous fibre, which however, is not always present, is somewhat analagous to the muscular fibre of animals; and, of the latter, the bones may be compared with the earthy matter, including the carbon, as well as the sulphur, silica, etc., which is found in all vegetation. It is the silica in the rind of the Endogenous plants which enables many of them to stand erect.

Irregular vegetation which we denominate Phytanomics, being Bions which resemble vegetables a little to be sure, but which have neither leaves, axis of growth, or proper roots. They are mostly *Acrogenous*, extending at their extremities but thickning not much in diameter after they commence to grow.

Lichens
Algas
Fungues

Phytanomics

Biomycetes

BIONOLOGY.

Among the different kinds of matter which belong to the earth, we find that some will unite together and thus constitute living beings; and the same we denominate *Bions.* They consist essentially of a tissue which is composed of oxygen, hydrogen, nytrogen and carbon, and which assumes a *celular* form, to a greater or less extent, in the whole of them and, in the most of them, one or more other forms such as the *vàscular, fibrous* &c. These bions, a synopsy of the different classes or primary groups of which, is herewith presented, consist of *Animals, Vegetals* and *Biomycetes*, the last mentioned group being intermediate betwixt the other two, and but little above the grade of inorganized matter.

Our object, which is the only one that should be proposed in this case, has been to make as many classes as can be distinguished each from all the others of the same or a superior grade, by a tolerably short and euphonous term, taken from the Latin, or the Greek, or from the generally prevalent scientific language of the age; and, if such a term could be applied to every specie, and even variety in the whole bionic kingdom, it should be done.

The reader will excuse the English form of the words *synopsy* and *specie*, and of every other similar one in this article. It is desired also, that he will permit us to adopt the term *vegetal* instead of *plant.* The first expresses *legitimately* any kind of vegetation in the abstract; while the other refers to some *cultivated* or *particular* vegetal, and in that sense we shall frequently use it. *Vegetable*, when used as a name, most commonly implies those portions of plants which we select for food.

Of the proper animals, we have thus distinguished *forty-six* classes; of the Vegetals proper, *fifty-four;* and of the Biomycetes, *fifteen;* making one *hundred and fifteen* in the whole; and to these we shall add, other classes by means of divisions, as fast as language shall enable us to distin. guish them from those we have made, in the manner above specified.

Nature often deviates from what we call system; and our business is to follow her as far as we can, and conform with her caprices, whether real or apparent, and not to attempt to mould her to ours. As all flowering plants are presumed to have a calyce and corol till the contrary appears, it becomes proper to indicate, not when these parts are present but when they are absent; and when one or both of them are absent and the circumstance does not appear in the name of the class to which such defective flower belongs it should be formally pointed out in a further description.

OF THE VEGETALS.

Class 1. The *Spadexogenas* are distinguished by their name from those which have a spadica among the Endogenas. They have no calyce and of course no corol; a circumstance, which, though indicated by the accompanying synopsy, is not so by their name, and of course it should not be considered superfluous to say so in this case. Of the class before us which are small fruticas or herbas, we have two families, the Peppers and Piperomas.—*Genus*, that barbarous term I never use.

Class 2. The *Spathexogenas* have no calyce. They cannot be put

with the last class because they seem not to have a proper spadica ; nor the last with this, because that last one has no spathe.

The one before us is distinguished by its name from those which have a spathe among the Endogenas; and we have three families of them; 1st. The ***Podostema***, the italic dress of which denotes that the plant is found in this region ; and the singular form, that we are aware of but one species of it here; 2nd. The Hydrostacies ; and 3d. The Lacies ; and perhaps others. Mr. Lindly admits that the whole group exhibits a dubious character, and that some botanists have placed them with the Endogonas. They are small and herban.

Class 3. The *Ovarinaments*, having no proper calyce are put here, although the scales of their ament may be considered as an imperfect one They include all the known plants, except the humuly or hop which must not be seperated from the *Urticates*, and possibly some other scattering ones, whose ovaries are found in an ament. And from these the spermagymnics are excluded, because of the latter the ovaries, if such imperfect things must be called so, instead of being found in an ament, constitute the scales of one, provided, what needs not to be granted in this case, that the cone should be called so.

Of the class before us we have two orders, the *Uniplacentates*, or those whose ovary exhibits but *one* placenta, and the *Biplacentates* those which have two of them.

Order 1st. Of the *Uniplacentates* we have two fraternities, the ***Platanins*** and ***Myricans***.

Of the ***Platanins*** which are large trees, we have two families, the ***Platany*** or Button ball, and the ***Liquidambar*** or Gumtree.

Of the ***Myricans*** which are fruticas, we have the ***Myricas*** or bayberry tallow bushes, the *Comptonia* or sweet fern, and the Casuarina, which is leafless. Here it may be readily perceived that the letter *n* affixed to a family name which terminates in a vowel, or *in*, to one that does not so, denotes a *fraternity*, and that a fraternity is a group of families which resemble each other too much to be separated into subgroups of more than one family each.

Order 2nd. Of the *Biplacentates*, which are generally large trees, we have two progenies, the *Salicans* and *Betulates*.

Of the *Salicans* one fraternity, we have two families; 1st the *Salicas* or willows, 22 species according to Beck; and 2nd, the *Poples* 8 species.

Of the *Betulates* we have two fraternities, the *Betulans* and *Ostryans*.

Of the *Betulans* we have two families; 1st. The *Betulas* or birches, 8 species; and 2nd. The *Alnies* or alders, 2 species.

Of the *Ostryans* we have two families, the *Ostrya*, or ironwood, and the *Carpiny* or hop horn-beam.

Here it will be understood, that the letters *te* affixed to a family name, which terminates in a vowel, or *ite* to one that does not so, denotes a progeny ; and that progeny is a group of fraternities, which resemble each other too much to be separated into subgroups of more than one fraternity each.

Class 4. Of the *Nomacalycates.* The term Acalycate implies the absence of a corol; as well as a calyce, for if a flower has but *one* of these two envelopes, that *one* must be a calyce; and if the reader will allow us to consider the spadica and spathe as *abnormal* modes of inflorescence, the prefix *Nomos* will exclude them from all acalycates; and the same term will exclude the spermagymnics, for they have a defect in the calyce and coral, so that *Nomacalycate* will imply an ordinary flower, neither spathate nor spadicate that is deprived of its calyce and coral; and of this class, which are generally small and herban, we have the same two orders of *Uniplacentates*, and *Biplacentates* which we had of the Ovarinaments.

Order 1st. Of the *Uniplacentates*, one fraternity, we have three families; Chloranthies, Ascarinas and Hedyosmies.

Order 2nd. Of the *Biplacentates*, we have *two* fraternities; 1st. The *Calitricas* one family, 3 species, which on account of their obvious affinity, to the *Halorogates*, Dr. Beck places as an annomalous family among them; and 2nd. The Saururins; and of these latter, we have two families, the Saururies and Aponogetons.

Class 5. The *Nucemoschifers*, one fraternity, are small trees or shrubs, and have no corol to their flowers, and we have two families of them, the Myristicas and Nemas or nutmeg trees.

Class 6. The *Juglandifers*, one fraternity, are large trees. They are *Apogynautophytandrous*, and have no corol to their flowers, and we have two families of them, the *Lomas*, 3 species, the black walnut, Madeira nut (exotic,) and butternut; and 2nd. The *Cayas* or hickories, 5 species, among which are the shagbarks.

Class 7. The *Depatocarpics* are mostly large trees. They are *Apogynautophytandrous*, and have no corol to their flowers, and we have two fraternities of them, the *Quercuns* and *Faguns.* The letters *s* and *m* I omit, when I find them at the end of a word.

Of the Quercuns we have two families; 1st. The *Quercues*, or oaks 23 species; and 2nd. The *Castaneas*, or chesnuts, 2 species.

Of the *Faguns* we have 2 families, the *Fagues.* or beach 2 species, and the *Corylies*, or hazle bushes, two species.

Class 8. The *Artocarpics* are large trees. They are *Apogynautophytandrous*, have no corol to their flowers; and we have several families of them; 1st. The Artocarpics or bread fruit; 2nd. The Ficues or figs; 3rd. The *Morues*, or mulberry, 2 species besides the exotic Multicaullis; 4th. The Brousonetas, or paper Mulberry; 5th. The *Maclura* or Ossage apple; 6th. The Cecropias; 7th. The Brosimies; and 8th. Even the poison Upa of Java, and perhaps others.

Class 9. The *Spermagonics* are generally herban. They are occasionally *Apogynautophytandrous*, and have no coral to their flowers; and of them we have 1st the *Polygonies*, which embraces the buckwheat and 18 other species; 2nd. The *Rumices*, or dock, sorrel &c., 9 species; 3rd. The ***Reum*** or ruburb, (exotic); 4th. Coccoloba, &c.

Class 10. Of the *Corticaromas*, which are shrubs and small trees, and ecorolate, we have, 1st. The *Laurues*, or sasafras and feverbush, 2 species in this country; 2nd. The Perseas; 3rd. The Litseas; 4th. The Tetranthies; 5th. The Cassythas, and perhaps other families.

Class 11. Of the *Nomasthephanics.*—The term *Astephanic* implies a calyce, because if the plant had none it would be an Acalycate; and the prefix, *Nomos*, may be considered as excluding every thing abnormal; and such we have concluded the spathe and spadica to be; and to these we must add the *Nutmeg*, *Depatc*, or burr and the *Juglandy* which are found in no other groups but the one which they are here made to indicate in the vegetable kingdom; and the same may be said of the fleshy head which is called a Fig, of the angular seeds of the spermagonics, and of the Aroma in the bark of the sassafras. They are all anomilies, so that Nomastephanic implies a plant that exhibits no peculiarity which distinguishes it from all others, except the absence of the coral; and of the class before us we have two ordars; the *Ovuledefinites*, or seeds indefinite; and the *Ovulindefinites*, or seeds indefinite; and here we have to remark that the rule for orders is precisely the same as that of classes, and two is the greatest number we can properly distinguish in this case.

Order 1st. Of the *Ovuledefinites* after many divisions and subdivisions, into *Nations*, *Tribes*, *Parties*, *Sections*, *&c.*, we have 23 progenies, or natural orders of botanists some of which, requiring no further subdivision, till they are resolved into families, may be considered as fraternities.

Order 2nd. Of the *Ovulindefinites* we have two nations; 1st. The *Unicelovaries*, ovaries with one cell, of which, after some further divisions we have 4 progenies; and 2nd. The *Multicelovaries*, ovaries with many cells of which after similar divisions we have three progenies.

Of the great class of *Nomexogenas*, we can make but two orders; the *Caliciflorας*, and *Thalamifloras*; for this is the greatest number of groups which we can distinguish each from the others, in the manner above mentioned.

Order 1st. Of the *Calicifloras*, we have two nations; The *Apocarpas*, and *Syncarpas*.

Nation 1st; Of the *Apocarpas*. Following Mr. Lindley, we have two tribes; 1st. The *Calyceadherents* (to the ovary) of which after some further divisions we have three progenies, besides the excepted, ***Pomifers*** and ***Rosates***; and 2nd. The *Calycelibers*, of which, after several more divisions, we have 5 progenies besides, &c.

Nation 2d. Of the *Syncarpas* we have the same two tribes which we had of nation 1st; and which are, 1st. The *Calyceadherents*, of which after many further divisions and subdiviions we have 19 progenies besides, &c., and 2nd. The *Calycelibers* of which after similar divisions we have 18 progenies.

Order 2d. Of the *Thalamifloras* we have the same two nations which we had of the *Calycefloras*, and which are the *Apocarpas* and *Syncarpas*.

Nation 1st. Of the *Apocarpas*, we have two tribes; 1st. The *Apogynanders* of which we have one progeny; the *Menispermics*; and 2nd. The *Syngynanders*; of which, after many further divisions, we have 11 progenies, besides the excepted *Magnolians.*

Nation 2nd. Of the *Syncarpas* we have two tribes; 1st. The *Placentaparietals* of which after the usual divisions, we have 9 progenies; and 2nd. *Placentacentrals* (though in consequence of the disappearance of the divisions of the ovary it is sometimes only one celled) of which after many divisions and subdivisions we have 39 progenies.

Of the *Nomolostephanics*, the next largest class that we have among the flowering vegetals, we can make pursuant to our rule, but two orders; the *Coroladherents* (to the ovary) and the *Corallibers*; and here it should be borne in mind, that the corol in those cases where it appears to arise from the calyce, or ovary is attached to the same, and must be considered as extending to the receptacle beneath the ovary; so that in all cases among the *corolintegers*, when the calyce appears to adhere to the ovary, it is the corol that does so, and the calyce to the corol, and when the corol appears to arise from the ovary it adheres to the same.

The *Normalabiates* exclude the orchies whose lip is upside down.

The other classes are all quite moderate as to size.

In this arrangement there is nothing that is new in *substance*, to be sure, but much that is so in form; and with deference it is hereby submitted to the consideration of Bionologists; and we presume that every one who deserves the name, will be ingenuous enough to ask himself, whether he has a better one to offer.

System is every thing in every thing, and pre-eminently so in the subject before us; and one who contributes even but little towards a natural arrangement of any group among the great subjects of nature, deserves well of mankind.

The following article will show that the subject of which it treats is exciting interest in England as well as in this country. It will be perceived that an important source of error is pointed out, in, the difference between the estimated and actual horse power, which latter in fact, varies constantly, and to be known for any particular expedient requires the pressure in the cylinder to be known, the amount of expansion, and the number of revolutions per minute.

From the London Civil Engineer and Architect's Journal of May 1840

MARINE ENGINES.—EMPLOYMENT OF THE EXPANSIVE PRINCIPLE TO ITS FULL EXTENT IN MARINE ENGINES, WITH A SAVING OF HALF THE FUEL.

Sir—In my remarks in your Journal of last month, I dwelt at some length on the advantages to be derived from the employment of the cornish double beat valve, in marine engines, especially the facility which such afford of working the steam expansively. But it may be asked why all this talk of working expansively where there is little or nothing to expand? I would answer this question by another: why adopt a good plan by halves?

take the cornish boilers also or a suitable modification of them, and raising the steam to 35 lbs. effective, carry out the principle of expansion to its full extent; this would at once reduce the consumption of coal one half, and so double the range of our steam navigation. On such a startling proposition as this being mooted, the question naturally suggests itself, how has this so long escaped the first men of the day? That I shall not attempt to answer; it is sufficient that it has escaped them, and a very slight examination of the matter will make this evident.

Thus taking the horse power at 33,000 lbs. lified one foot per minute with a consumption of 8 lb. of coal per hour, and this is below the average consumption, we get a duty of 23,000,000 (though 20,000,000 would be nearer the mark, especially in steamboats).

If any be disposed to assert that this is overstated as regards the Great Western and British Queen, as these vessels are said to consume above six or seven pounds per horse power per hour, I answer, the Queen's engines are 500 horse power at 15 strokes per minute, or the piston travelling through 250 feet per minute, now the pressure of steam, &c. remaining the same, the power exerted by the engine is exactly as the space through which the piston travels; but 12 strokes per minute is nearly the average number the engines make, as appears by her log, this reduces her power in the ratio of 15 to 12, and increasing the consumption of fuel per horse power in an equal ratio, makes the six or seven pounds nominally consumed equal to 8 or 9.

Whereas many of the Cornish double acting crank engines used for stamping ores, the most trying work an engine can possibly be subjected to, and where there is greatest loss by friction, are doing a duty of 50, 56, and even 60,000,000, as appears from the authenticated reports of the engineers.

Although this will not be doubted by any one who has had the opportunity of seeing the engines at work, it may suit some to doubt and even to deny the truth of these reports; so they did those of the pumping engines doing a 70 or 80,000,000 *duty*; but as 90 and even 100,000,000 is now being done under their eyes, what credence can such men expect for any statement they may in future make.

Having had occasion to visit Cornwall some three years ago on business, immediately after having completed the engines of a large vessel now on the London and Dublin station, the easy valves, the cool engine room, and almost smouldering fires of the Cornish engines, as contrasted with the stiff and heavy sides, the suffocating heat of the engine room and roaring furnaces I had just left, attracted my particular attention; and though possessing at that time no data beyond the published reports of the engineers, I saw enough to convince me of their immeese superiority, and at once set about considering how the same plan could be carried out in marine engines, a point which I hope to be now able to make clear, and the objections to which I shall endeavor to deal with in detail.

The first is the increased danger of explosion or collapse supposed to be occasioned by the great density of steam.

The second is the additional strength required in the engines to withstand steam of such density when first admitted into the cylinders.

The third is the increased weight of the boilers, and the extent of flue surface required for their successful application.

The first objection, the increased danger, I shall begin by denying "in toto," nay, it appears to me that there is absolutely increased safety: for the following reasons:

Setting aside the increased weight, &c., one boiler can be made quite as

the safety valves would have much less tendency to stick fast under the capable of supporting a pressure of 35 lbs. as another is of supporting 3 lbs., higher pressure, and their becoming a little stiff, or two or three pounds overloaded, would not be of the slightest consequence on a boiler calculated for a pressure of 35 lbs., though it would have a very dangerous tendency on one calculated for 3 lbs.

But the great argument for increased safety is this: it is an established fact, that with boilers of the usual construction, nine-tenths of the steam boat accidents occur through collapse of the overheated flues, much more than from any excessive pressure of steam in the boiler; nor is this to be wondered at if we consider how the fires are urged. Now with the Cornish boilers and a proper system of expansion, the same work can be done with half the coal, and if we consume only half the coal on the same or a greater extent of fire bar and flue surface in a given time, then it follows clearly that we have a fire of only one half the intensity, and the risk of collapse from overheated flues diminished in like proportion. But if these arguments are insufficient, then the following fact is greatly in their favor, viz: that as few if not fewer accidents occur in Cornwall where such boilers are in universal use, than in any part of the kingdom where steampower to a like extent is used; and if it be further true, as I have heard stated both in Cornwall and elsewhere, that many of the Cornish engineers will engage to keep up the boilers for ever, for the annual sum of five or six per cent on their original cost, such an argument appears to me, as it will to most practical men, to be at once perfect and conclusive.

I now come to the increased strength required in the engines, and this on examination will appear trifling. To commence then with paddle-wheels, as they remain of the same size, and are driven at the same speed, no alteration is required in them, and of course the same remark will apply to the paddle-shafts through which the power is transmitted. These being subjected to no increased strain as the average effective presssre upon the piston which takes place when the piston is half stroke, &c., and the crank is at its point of greatest torsion, is the same as in a common engine. The intermediate shaft alone with its cranks, in which the crank pins are *fast*, requires additional strength, and as this shaft is only about one-sixth the length of the two paddle shafts, and the strength of a shaft increases as the cube of its diameter, the increased weight will be trifling: next there is the top frame that carries this shaft, and the bottom frame supporting the gudgeons and colums, the strength of both must be increased, and it is as the square of their depth; next comes the piston rod, this will do as before, the piston rod of a large engine being equal to 20 times the strain that it is ever sbbjected to: the same remark will apply to the malleable iron columns supporting the top frame, as each of them is usually made of the same strength as the piston rod.

The piston must be strengthened, but the cylinder will do as before, as it is strengthened at the extremes where the greatest pressure of the steam is by its flanges, and in ordinary cases we are under the necessity of making it much stronger than necessary to ensure a sound casting, and also to support the framing attached to it; besides a cylinder of three fourths the capacity is sufficient for the same power, so here we are positive gainers in two most importent points, strength and space. The gudgeons of the cylinder of double the strength will not be stronger nor heavier than the main centres of the beam engine of the ordinary construction must necessarily be.

The points then which require increased strength are, the intermediate shaft and gudgeons, the top and bottom supporting frames, and the piston. The increased weight from this cause would not exceed 6 or 8 per cent.

beyond that of the same description of engine at the ordinary pressure, and after taking this into account, the total decrease, by ading to the vibrating cylinder, would be at least 25 per cent.

I now come to the question of increased weight in the boilers, and this I shall be able to show is not nearly so great as may at first be supposed.

It will scarcely be disputed that the same thickness of plate in cylinders 6 feet diamater, the size of the exterior cylinder of the cornish boiler, will bear a water pressure at least 3 times greater than if arranged in the usual form of a steam-boat boiler; or that the former of $\frac{5}{16}$th thickness would bear without flinching a proof pressure of 60 or 70 lbs. to the square inch, while the latter would give evident signs of weakness at 20, although ever so well stayed. If then it be considered perfectly safe to work steam of 6 or 7 lbs. pressure, in a boiler which would give evident signs of weakness under a pressure of 20 lbs., surely it is equally safe to work steam of 30 or 35 lbs. in a cylinder of 6 feet diameter, and $\frac{1}{2}$ inch thick, which would bear without the slightest signs of weakness 120 lbs. on the square inch, boilers of this size and thickness being usually worked to 40, 45, and even 50 lbs. per square inch. Then 4 feet diamater, and $\frac{7}{16}$ths thickness will be ample for the internal cylinder, and to make security doubly secure, let a strong angle iron be rivetted round the internal cylinder at distances of about 2 feet apart, this would keep the cylinder or arch perfect, and so prevent the possibility of a collapse, with but trifling addition to the weight of the boilers.

Now taking equal extent of common and Cornish boilers, the former taking all stays, &c., into account, will barely average $\frac{3}{8}$ths in thickness, while the latter with its internal tube of 18 inch diamater, and $\frac{5}{16}$ths inches thickness, would average about $\frac{1}{2}$ inch. This makes their respective weights at 3 to 4, but in order to the successful application of slow combustion we require addition flue surface, so take 3 to 5 as the ratio of the weight of common and Cornish engines and water for the same power, the extra space required for the boilers being much more than compensated, by the small space occupied by the vibrating engine.

But to go more minutely into the matter, the weight of a Cornish boiler and water of the size and thickness named, and 35 feet in length, is = 24 tons, exposing a surface 938 feet: eight such boilers might be easily set in the space allowed for the Queen's boilers, now 8 × 24 = 192 tons, as the weight of the boilers, and allowing 50 tons for setting and clothing, we have 192 + 50 = 242 tons, total weight of the boilers, and setting, &c.; 938 × 8 = 7504 ÷ 500 = 15 feet surface per horse power, being one-half more than the usual allowance without increasing the weight of the boiler at all, or occupying more space in the vessel.

But allowing that we have increased the weight of the boilers in the ratio of 35, let us take the British Queen as the subject of comparison.

The total weight of her engines and boilers is 500 tons, and of this 220 may go in round numbers for boilers and water, and 3 : 5 : : 220 : 366, and 500 — 220 + 366 gives 664 — and less 64 tons being the decreased weight of the vibrating engnie = 600 tons, as the weight of her engines and water on the Cornish plan.

The account would then stand thus on the present plan,

Engines and boilers, - - - - - - -	500 tons
20 days fuel, - - - - - - - - -	750
Total, - -	1250

On the Cornish plan,

Engines and boilers, - - - - - - -	600
20 days fuel, - - - - - - - - -	375
Total, - - -	975

Showing a capacity for 285 tons more cargo, and a saving of 375 tons of coal.

Though some may consider these figures as exaggerated without being able to assign any reason to themselves or others, save that the plan is impossible. Those who have examined the subject will assuredly blame me for not having gone far enough; and there is another class of well meaning men among engineers and others, who have imbibed such a reverence for the name of Watt, that they almost consider any deviation from the plans he followed, or improvements upon the state in which he left the steam engine, to be an insult to his memory, and a deduction from his fair fame; but my admiration of Watt is as great as any man's can be; I am proud of him as a countryman, and honor him as a great man, and so have endeavored to add a stone to the monument he has raised, by carrying out a principle which in his third patent of 1782, he distinctly propounded, and of the advantage of which that great man seems to have been fully aware, though he lived not to see it carried into effect.

If then I am borne out in these statements, and to disprove the main point, the grert increase of duty by expansive working is altogether impossible; and the others I think I have succeeded in making tolerably clear, though on some points as the weight of the present boilers and water of the British Queen, I may have made some slight mistake not amounting to a few tons either way, having assumed it from comparison with others, and not stated it from actual knowledge, yet on the other hand I have underrated the saving of fuel, and allowed quite enough for the increased weight of the boilers, as there is less due to the great extent of surface than is supposed, the expansion being the point where the power is gained; and however the proposition of adopting steam of increased density may be cavilled at, to the priniple of expansive working and slow combustion we must come at last, and by adopting them to their full extent, which I think I have shown to be equally safe and perfectly practical. The Cape of Good Hope is as much withln our reach as New York now is, and a speedy and sure passage open to our Indian and Australian empires.

Such then being the case, are we content to allow our preconceived ideas to supersede our better judgment, and go on loading our vessels with unnecessary coal, and thus uselessly consuming our most valuable mineral—limit at the same time the range of our steam navigation, and the civilization of the world at large; or do our engineers mean to allow that they cannot make a boiler safe under a pressure of 35 lbs., or that one of the thickness and diameter that I have proposed would not be perfectly safe under that pressrue. If they allow neither of these propositions, then the sooner the subject is seriously taken up the better, as every boat now fitting with the usual beam or side lever, engines, (and many of the splendid mail packets are being thus fitted,) is incapable of being afterwards altered, so as to work expansively, as though the boilers may be altered, the beams, &c., would never stand the increased pressure.

Before concluding, perhaps I may be allowed to correct an omission in my last paper. It is a favorite remark of naval men, "get as extended a hold of the vessel as possible." Now it has often struck me, not only in those vessels I have myself been engaged in, but in every one I have had the opportunity of seeing, that this very reasonable remark is not only not complied with, but that the power is positively brought to bear on the wrong place. Thus no attempt that I have seen has been made to lay hold of the vessel fore and aft, in a line with the centre of the paddle shaft, but the framing is stayed sideways, or at best slightly supported by the most contiguous deck beams, and the horizontal strain of the propelling power acting at the bear

ings of the shaft, the engine frame is thus used as a lever to wrench the under frame of the vessel as it were assunder, and an action is thus created tending materially to weaken the vessel and increase the unpleasant vibration, to remedy this defect, and at the same time to prevent the framing and joints of the engine from breaking, uncommonly heavy bed plates have been resorted to; those on board the British Queen, amounting at least to 23 tons; now without entering into a discussion on the point, what I propose is this, let a strong flat bar of wrought iron be carried fore and aft opposite each engine, gradually tapering away, and running in towards either side of the vessel, being at the same time securely bolted through ten or twelve of the deck beams, on the end of this next the engine, let there be a strong joint and a similar one on the engine frame joined by a strong connecting rod, this would allow sufficient play, and at the same time, if I may use the expression, give the porter a hold of his load by the right place.

To conclude, if it be considered that I have not gone sufficiently into detail completely to prove every point I have advanced, my answer is, I have considerably underrated the gain, and overrated the loss, thus rendering minute calculation of strength and weight uncalled for; besides such would have been of no value to any one not intimately acquainted with the subject, and practical men can examine it for themselves.

My object has been to keep the main points of the argument in view, and to make it intelligible to all classes of your readers, and in this I hope I have succeeded, and should you or any of your readers be able to furnish me with the exact weight of the boilers of the British Queen, and the space they occupy, with any further particulars, I will in a future number enter more minutely into the subject, and illustrate by a few sketches my ideas of how the boilers on the Cornish plan should be set and clothed, and where the extent of surface I have spoken of is obtained; having no doubt that I shall be able to establish every point that I have advanced, bearing on the increased safety and economy of the plan proposed, and at no distant period see it carried into successful operation on a scale commensurate with the importance of the undertaking, and the vital influence which such an improvement would have on our political and commercial relation with all parts of the world.

Pimlico, April 4, 1840. A. S.

ON BLASTING LIMESTONE ROCK.—*Some account of blasting the white limestone, in the county of Antrim, in Ireland.* By William Bald, F.R.S.E., M.R.I.A., &c. Read before the Institution of Civil Engineers.

It becomes necessary to make a few short observations which may perhaps be interesting to the scientific engineer. Along the north coast of Ireland from the Bay of Belfast to Lough Foyle, the country consists of white limestone; columnar basalt, and some conglomerate sandstone; but the hill of Carey consists of mica slate; and is of the same formation as the Mull of Cantire, a part of the coast of Scotland lying opposite. The geologist can here easily trace the connecting link in the formation, which joins the two countries, although a chanel 90 fathems deep seperates them. Numerous whin dykes intersect the strata along this part of the Irish shore, they run nearly parallel to each other in some cases, and are very remarkable in their structure.

The study of the peculiar qualities of the respective rocks and strata, and their position and inclination, will enable the engineer to work them in a more scientific manner. And in the construction of harbours, lighthouses

lines of navigation, drainage, roads, &c., &c., an intimate acquaintance with the component parts of the rocks, will enable him to select those best suited to resist the action of time, whether they be placed under the dominion of the deep, exposed to the ravages of the pholas, or subject to perhaps the more wasting influence of the atmosphere; by such studies his skill will be alike visible in the selection of the best material for the repaving of even a common road, as it will be for that of the most splendid edifice destined to survive ages.

In constructing the Antrim coast road it became necessary to cut through extensive and high masses of white limestone; one of the sea cliffs in the Little Deer Park, near Glenarm Town, extendnd to a length of nearly one thousand yards, rising from twenty feet to about two hundred in height, washed at its base by a deep sea, and entirely exposed to the run of the ocean in the north channel.

Above the white limestone is situate the columnar basalt, but no part of the road was cut through this last mentioned rock. The white limestone in Antrim differs from the chalk in England, in being more indurated, while in other respects it is similar to it in the quantities of flint it contains. This rock is close and fine in its texture, but it is deeply fissured in many directions; the scull veins it exhibits are extremely curious.* The inclinations of the limestone strata on this part of the coast does not in general exceed 15° dipping into the land. Under the limerock strata lies the brownish red coloured sandstone.

In blasting down those lofty cliffs of white limestone, the borings were always made into the toe of the rocks, and were so arranged that the line of least resistance should not be in the direction of the line of boring. Hundreds of tons of rock frequently rested on a base of a few superficial feet, which being blasted away, the cliff above tumbled down. The patent safety fuse was used, and which was attended with the most beneficial results, copper tubes, for putting in the charges, and also copper needles.

During three years operations not a man was lost, although upwards of one hundred thousand tons of limestone were blasted down upon less than one mile of the road.

The following are the results of a few experiments made upon loose detached blocks of white limestone at Glenarm, Little Deer Park.

	Cubic feet in each block.	*Quantity of powder used.*	*Cubic feet for each ounce of powder used.*
Block No. 1.	165	12oz	1378 ft.
2.	180	12 oz	1500
3.	540	38 oz	1421
4.	864	64 oz	1350

From the above experiments it took one ounce of gunpowder to rend asunder 14·12 cubic feet of the white limestone when in blocks. And from experiments made on the solid loose whinstone blocks, it took about one ounce of gunpowder to blast asunder 11·75 cubic feet.

Three experiments assigned the specific gravity of the white limestone at 2,747, 2,769, 2,763; and the whinstone or basalt at 3,200, being about 13 cubic feet of white limestone to the ton, and 11·20 cubic feet of the whinstone to the ton.

* The grey limestone with which the light-house of Clare island is built, is much traversed by scull veins, and water enters them during severe rain storms.

TABLE OF THE WORKING PROCEEDINGS.

		Depth of boring.	Quantity of powder.
An auger of	$1\frac{1}{4}$ inch diameter.	15 inches deep.	6 inches.
ditto	$1\frac{1}{2}$ ditto	26 ditto	8 ditto
ditto	$1\frac{7}{8}$ ditto	30 ditto	9 ditto
ditto	$1\frac{7}{8}$ ditto	36 ditto	12 ditto
ditto	$1\frac{7}{8}$ ditto	48 ditto	17 ditto
ditto	2 ditto	5 feet	20 ditto
ditto	2 ditto	6 feet	27 ditto

The above table exhibits the diameter of the auger or jumper used, the depth sunk, and the number of inches of gunpowder put in. (One pound of gunpowder occupies 30 cubic inches).

The force of the explosion of gunpowder is assumed to be as the cube of the length of the line of least resistance, thus if one ounce of gunpowder will open a distance of one foot of rock, the table would run thus:—

Line of least resistance.	*Charge of powder exclusive of priming.*
If 1 foot of rock requires - -	1 oucce
2 feet would require - -	8 ditto
3 - - - -	27 ditto
4 - - - -	64 ditto
5 - - - -	125 ditto
6 - - - -	216 ditto
7 - - - -	343 ditto
8 - - - -	512 ditto
9 - - - -	729 ditto
10 - - - -	1000 ditto

I am aware there is much difficulty in knowing exactly where the line of least resistance is, because the rock may be fissured, or some bed or opening may be near to the line bored, and this is the case where the rocks are stratified; but the hypogene rocks, such as granite and syenite, lying in large solid compact masses unstratified will be different, and these rules may be usefully applied. In blasting assunder loose detached blocks, a much greater quantity of material will be blown assunder by the same quantity of gunpowder than of rocks lying in close connected beds.

It is always desirable to work the rock out by the dip of the inclination of the strata, or as the quarrymen call it the going way of the rock.

In the white limestone quarries lying in the high ground north of the town of Belfast, where the limestone is quarried for building and agricultural purposes, and also for export; two men will quarry out at an average from eight to ten tons per day, the augers or jumpers generally used are $1\frac{5}{8}$ inches, and two inches diameter; and the induration of the white limestone may be estimated when two men will bore one foot deep in half an hour; they generally put in about three inches of powder for 15 inches deep, and 6 inches for about two feet deep; the expense for quarrying is about from five pence to sixpence per ton. There are nearly 13 cubic feet of the white limestone to the ton, which is at the rate of nearly about one shilling per cubic yard. This white limestone is much esteemed in Glasgow and all the towns on the Clyde, where it sells for five shillings per ton—but the quarrying works near Belfast are carried on in a very limited manner, or rather on a very small scale.

Numerous experiments made by military engieneers, assign the force of the explosion of gunpowder to be as the cube of the length of the line of least resistance. Vauban and Belidor, both of them excellent mathematicians, and also possessing great practical skill, ingenuity and experience, investigated this subject, doubtless more particularly with a view to the op-

erations of war, than to those of the works of the civil engineer. The law of the explosive force of gunpowder remains the same in all the various forms it may be applied to matter, whether in blasting out of rock or earth, or the destruction of the masonry of fortifications by blowing them up, or laying in ruins bridges built over large and deep rivers to arrest the progress of hostile armies.

The total cubical contents of the four blocks of limestone given above, amounted to 1749 cubic feet, and the quantity of powder used 126 ounces, being at the rate of 1.94 ounces for each cubic yard blasted asunder. But if the rate per cubic yard be deducted from the quantity of powder expended on each block, then the following will be the results obtained from the four experiments.

165 cubic feet was blasted asunder by 12 ounces of gunpowder, which is at the rate of 1·96 ounces of powder for each cubic yard.

180 cubic feet was blasted asunder by 12 ounces of gunpowder, which is at the rate of 1·80 ounces of powder for each cubic yard.

540 cubic feet was blasted asunder by 38 ounces of gunpowder, which is at the rate of 1·90 ounces of powder for each cubic yard.

8 64 cubic feet was blasted assunder by 64 ounces of gunpowder, which is at the rate of 2 ounces of powder for each cubic yard.

Therefore in the large loose limestone blocks about two ounces of gunpowder may be taken as the expenditure being necessary to blast out each cubic yard. The four blocks on which these experiments were made, were not at all cubical, although the one which contained 540 cubic feet was nearly so. From the above results I beg to submit some calculations regarding the force of the explosion of gunpowder, being as the cube of the length of the line of least resistance.

We are in possession of the quantity of gunpower used in blasting the 4 blocks, and also of the solid feet contained in each of them. Extracting therefore the cubic root of the cubical contents of each block, we shall then have their masses all in cubical form as follows:

Cubic feet in each block.		*Side of the cube.*
$\sqrt[3]{165}$	- -	5·484
$\sqrt[3]{180}$	- -	5·646
$\sqrt[3]{540}$	- -	8·143
$\sqrt[3]{864}$	- -	9·524

Taking the length of the line of least resistance at each of thsee cubes to be equal to the distance from the centre to the nearest point on the surface, or equal to half the side of the cube, then the following will be the lengths in feet of the lines of least resistance.

In cube No. 1 — 2·742 feet.
No. 2 — 2·823
No. 3 — 4·071
No. 4 — 4·762.

The quantities of gunpowder consumed to blast asunder a line of least resistance, of

2·742	feet was	12 ounces,	165	cubic feet blasted asunder.
2·823	-	12 ditto,	180	ditto.
4·071	-	38 ditto,	540	ditto.
4·762	-	64 ditto,	864	ditto.

If 165 cubic feet be blasted asunder by 12 ounces of gunpowder, the line of least resistance in that mass, if in cubical form, will be

$$\sqrt[3]{165} = 2.742 \text{ feet.}$$

Then the line of least resistance for one foot in cubical form will be equal

to 8 cubic feet. Then if 165 cubic feet with a line of resistance of 2·742 feet require 12 ounces of gunpowder to open it, then 8 cubic feet with a line of resistance of one foot will require 0·582 ounces of gunpowder to open it asunder.

The following are the quantities of gunpowder required to open one foot of least resistance through the white limestone, as determined by the blasting of the four blocks.

Cubic feet in each block - -	165	180	540	864
Quantity of powder used to rend it asunder, in *ounces* - - -	12	12	33	64
Cubic feet opened by the line of resistance of one foot - -	8	8	8	8
Quantity of powder required to open the line of least resistance of one foot, in *ounces*, - - -	0·582	0·533	0·563	0·593

Mean 0·568

Apply the rule of the cube of the length of the line of least resistance, and working with the element just obtained from the four experiments, to open asunder the line of least resistance of one foot.

No. 1—Then the scale of the length of the line of least resistance in No. 1, $2{\cdot}742^3$ feet multiplied by 0·582 ounces, the quantity of powder to open one foot will be $2.742^3 = 20{\cdot}62 \times {\cdot}582 = 12$ ounces.

No. 2—For a line of least resistance of 2·823 feet will be 11·95 ounces, $2{\cdot}823^3 = 22{\cdot}42 \times {\cdot}533 = 11{\cdot}95$ ounces.

No. 3—For a line of least resistance of 4·071 feet, will be 37·97 ounces, $4{\cdot}071^3 = 67{\cdot}45 \times {\cdot}563 = 37{\cdot}97$ ounces.

No. 4—For a line of least resistance of 4·762 feet, will be 64 ounces, $4{\cdot}762^3 = 107{\cdot}983 \times 593 = 64$ ounces.

It is therefore, clear from these experiments made that the force of the explosion of gunpowder is as the cube of the length of the line of least resistance. Taking the mean quantity of gunpowder obtained from the four experiments to open asunder a line of resistance of one foot, and which is 0·568 ounces. The following will be the results calculated according to the cube of the length of the line of least resistance.

$2{\cdot}742^3 = 20{\cdot}62 \times 0{\cdot}568 = 11{\cdot}71$ oz. $= 165$ cubic feet.
$2{\cdot}823^3 = 22{\cdot}42 \times 0{\cdot}568 = 12{\cdot}73$ oz. $= 180$
$4{\cdot}071^3 = 67{\cdot}45 \times 0{\cdot}568 = 38{\cdot}31$ oz. $= 540$
$4{\cdot}762^3 = 107{\cdot}983 \times 0{\cdot}568 = 61{\cdot}33$ oz. $= 864$

In having described the mode of blasting the white limestone on the Antrim coast road in the north of Ireland. It may be useful as well as interesting to the engineer to describe its qualities, and to what extent it may be employed in the construction of works.

In treating of the nature of any kind of material to be employed in building, the first consideration is its character, to resist decomposition whether placed in the open air exposed to the full action of the atmosphere, or buried in the earth, or entombed in the deep. Its induration and compactness of structure, the absence of figures, the mass it can be had in, and the facility of working or tooling it into form.

The white limestone on the Antrim coast road lies in beds dipping slightly to the plane; it is generally quite white, but sometimes it is of a yellowish tint; it is traversed by very small veins of calcareous spar, but the most remarkable feature is the quantity of flints it contains, they are dry, grey and black; the thickness of the beds of the white limestone is very singular, being sometimes more than 30 feet.

This white limestone is not good for building, because it moulders by

exposure to the atmosphere, it is not therefore generally used in any public building, although it might be used in filling up the interior parts of walls; it is inferior for road metal, being tender and wearing quickly; it can be procured in large masses, when reduced to pieces containing six, twelve and eighteen cubical inches, it breaks into irregular fragments with sharp edges.

The white limestone when placed under the sea is particularly subject to the ravages of the pholas, and is therefore unsuitable to be employed in the construction of marine works, such as harbors or breakwaters, &c., it is however a valuable material for making lime for building, and for agricultural purposes. In our quarrying operations we rarely found in it shell remains.

In quarrying it out in large masses, the blocks sometimes had what the workmen call a lean and a full bed; the lean bed being less than an angle of 90°, and the full bed more than 90°.

The white limestone can be split with plug and feather, or pooled by wedges; if the stratification be in thin beds, it opens across with a very rugged and irregular face, but if very solid and compact, and the beds of great thickness, it will open more evenly and equal in the face. It dresses readily with the hammer, and can be wrought and hewn into any form. I am however of opinion, that the white limestone of the county of Antrim, should not be used in constructing any work requiring durability, because it is a rock liable to decomposition, when exposed to the atmosphere.

I have already, in the paper on blasting the white limestone, alluded to the small fissrues which traverse that rock, and which also traverse the blue and grey limestone of Ireland, and which the stone cutters call scull vein doublers, on account of their exact resemblance to the sutures in the human scull.

In concluding, I beg to mention that there are several species of the Pholas Lamarh in his natural history, mentions the Pholade Dactyle or Pholas Dactylus, as being very prevalent on the coast of France, and also inhabiting the shores of the British seas. I have given a sketch of the Pholas Dactylus, and I beg to present to the Institution a very beautiful specimen of this kind, from which the sketch has been made, and which specimen I have accidentally obtained in London. There is another species called the Pholade Scrabrelle, or Pholas Candida, which inhabits the European seas, and a very small kind called by the French Saxicave Ridee, Saxicava Rugosa. It is quite foreign to the object of this paper, to enter into any thing like giving an account of the various kinds of Pholas, or their habits; it is quite sufficient to the engineer to know that every description of calcareous rock, when placed under the sea, is subject to be perforated by those bivalves; indeed every rock upon which acids act are subject to be destroyed by them, and it consequently has been conjectured that they possess the power of producing an acid that decomposes the rock containing calcareous matter; on the other hand some maintain this is not the case, because the acid would also decompose the shell that covers them. Mr. Lonsdale, of the Geological Society, mentioned to me that some marine works constructed at Plymouth were much injured by the ravages of the Pholas. Beds of calcarous rock of several feet in thickness, in the Frith of Forth have been entirely destroyed by the Pholas.

It will be seen that the shell of the Pholas Dactylus, presented to the Institution, is very tender and delicate; from the extreme fragile nature of the shell it would not be supposed capable of destroying indurated marble. The external surface of the shell is rough, and radiated transversely and longitudinally in a most beautiful manner by curved lines of a high order; an attentive study of the mere lined surface of the shell cannot fail to be instruc-

tive even to the man of science, and worthy to be contemplated and examined by all those engaged in the works of art and taste. The marine engineer may derive instruction from the parabolic curves delineated, and traced out by the hand of nature on the Pholas shell, in assisting him in giving the best shape to the slopes of breakwaters, and harbors constructed in the deep sea, and exposed to the run or momentum of the ocean. The curved radiation or fluting on the shell cannot fail to attract the architect engaged in the works of design and taste. It ought not to be forgotten what struck Watt in examining the joints in the tail of a lobster; nor of Smeaton in looking at the form of an oak tree; nor the falling of an apple which gave the impulse to the genius of a man justly the glory of our island; and whose name stands recorded with the proudest triumphs in the loftiest branches of science that has yet adorned the efforts of human ingenuity.

WILLIAM BALD.

BRITISH AND AMERICAN STEAM NAVIGATION COMPANY'S SHIP PRESIDENT.

This ship will leave Liverpool for New York on the 1st of August, and is undoubtedly the largest and most splendid steam ship that has ever been built. She measures 350 tons larger than the British Queen, with which ship she is to keep up a monthly communication between this port London, and Liverpool, sailing alternately the first of each month. The President will depart regularly from Liverpool, and the British Queen from London.

The annexed particulars will give the public some idea of her arrangements, which are on a scale to reflect the highest credit to the enterprising company owning her.

The accommodations for passengers in this magnificient ship are of the very first order, combining the advantages of ample light, air and space with the richest and most elegant decoration.

The upper deck consists of a saloon or dining room 31 feet wide by 28 feet long, communicating by a double entrance, with a wide and lofty corridor, which reaches entirely to the after part of the ship. On each side the corridor are spacious state rooms for first class passengers, excellently lighted and ventilated, not entered as they usually are, immediately from the public walk, but from seperate passages, each containing a large window. At the other end of this deck is a commodious room expressly for the ladies room, and a large state room for a private family.

The style of decoration of the whole is the Tudor Gothic of the 13th and 14 centuries.

On entering the dining saloon from two lobbies, the appearance of it is very quiet and chaste. The panneling on all sides consists of Gothic work, richly carved, and painted to imitate new oak highly polished, the ground of the pannels being of a simple neat color. The furniture is all of real English Oak, highly polished, with Gothic carving, and covered with embossed Utrecht velvet of a rich brown color. The dining tables are four in number, placed lengthwise of the ship, and when fully extended, will accommodate 120 persons to dine.

The sofas are placed along the sides of the room and at each of the four windows. There are four handsome gothic sideboards, neatly fitted up with the portraits of a "President" (Washington being one) over each. The whole, with the help of several mirrors, has an exceedingly light and elegant effect.

The ladies cabin, is also a very neat and elegant room, being richly ornamented in the Gothic style, in colors of white and gold, and the walls

hung with a pleasing imitation of tapestry, of a grey color, having the English rose and the American star in neighborly proximity.

The corridor, however, is the part which for richness of effect and merit of design, exceeds all which we have hitherto seen on board any ship, resembling rather a gallery in a nobleman's mansion.

The ceiling, the lantern lights, the walls and the doors, are of the richest carved Gothic work, painted in imitation of old oak wainscoting, and on both sides, the walls are hung with paintings (in imitation of ancient tapestry) on a rich crimson ground representing the history and achievements of the great Columbus, comprising all the most important events of his life, among which, and not the least conspicuous, is his discovery of America. These subjects are extremely well designed and painted, especailly when the difficulty of the imitation of needlework is considered, and are all original compositions.

It should be remarked that the adaptation of the Gothic architecture of his time, and the story of Columbus, to a ship named the President and designed for the American trade, is in excellent taste.

We would call attention also to the manner in which the introduction of light and air to the lower deck is made ornamental to the corridor itself, by the construction of a parterre of flowers, and an exceedingly light and neat spiral staircase, which is the medium of communication between the two decks.

The lower deck is laid out simply into spacious light and airy passages. and state rooms, in which every contrivance for comfort which art can suggest, has been attended to. The whole will accommodate 116 to 120 persons, and all so well, that we should be puzzled which berth to give the preference to.

The whole of the fittings up, decorations and furniture, are designed and executed by Mr. B. H. Simpson, 456 West Strand London, who also fitted up the British Queen.

The figure head of the President will be a full length likeness of Geneneral Washington; and a capital likeness it is. It will be gilt.

The following is a list of the subjects introduced in the tapestry:

No. 1. A. D. 1470.—Columbus selling maps and charts at Lisbon, for the support of his family and aged father at Genoa.

No. 2. A. D. 1470.—Columbus contemplating his enterprise, is kindled into enthusiasm by considering himself to be the person alluded to in holy writ, who is to carry the gospel into new lands.

No. 3. A. D. 1484.—Columbus begging bread and water for his child at the Franciscan Convent of St. Rabida; Juan Perez Marcheza passing by, is much struck by his appearance.

No. 4. A. D. 1484.—The conference at La Rabida, at which Juan Perez Marcheza and the Physician Garcia Fernandez, are struck by the grandeur of his views.

No. 5. A. D. 1492.—On Friday, 3d. August, 1492, Columbus set sail as Admiral of the seas, and the land he expected to discover. On the 11th October, Columbus stood on the stern of his vessel, when he espied land at 2 o'clock in the morning. The foremost then fired a signal.

No. 6. A. D. 1492.—Columbus landed and gave thanks to heaven for the success of his enterprise. At dawn, on the 12th October, he landed in the new world, at Guanahani or St. Salvador, one of the Bahama Islands, when the most mutinous and rebellious of his crew thronged around him and embraced his feet. The naked and painted natives regarded the white men as visitors from the skies.

No. 7. A. D. 1492.—Columbus entering Barcelona in triumph. In

his journey through Spain he received princely honors all the way to Barcelona where the Court then was. Several natives returned with him.

No. 8. A. D. 1493—Columbus received at Court by Ferdinand and Isabella, who rose as he approached, and raised him as he kneeled to kiss their hands.

No. 9. A. D. 1500.—Columbus arrested. Notwithstanding his great successes, his enemies at home persuaded the king to supersede him, and Francis Baradilla was sent to bring him back in chains.

No. 10. A. D. 1500—Columbus's arrival at Cadiz, a prisoner, chained —which event caused so universal a burst of indignation throughout Spain, as to compel Ferdinand to disclaim all knowledge or share in the disgraceful transaction.

Columbus born 1446, at Genoa; died, aged 61 years, in neglect and poverty.

"Thus ended," says the Historian, "a noble and glorious career, inseparably connected with the records of the injustice and ingratitude of kings."

PASSAGE OF RAILWAY TRAINS OVER THE MENAI BRIDGE.

From the Commissioners Report on the proposed Railway Communication between London and Dublin.

From Penman Mawr the lines (of Mr. George Stephenson and Mr. Giles) follow a course in which there is not any essential difference until they reach the corner of Penrhyn Park.

Here Mr. Stephenson proposed to pass under the turnpike road; then over the river Ogwen, by a bridge 37 feet high, with embanked approaches, and afterwards through a cutting five-eights of a mile long, and 45 feet deep.

The line then crosses the river Cagen and the valley through whch it runs by a short, viaduct, and an embankment 350 yards long, the extreme height of the former being 75 feet; this brings it to the ridge on the east side of Bangor. By cutting a tunnel 490 yards in length through this ridge the line would open on the Bangor valley, and pass Castle-street by a viaduct 35 feet high, and 125 feet long. It would then cross the valley, by an embankment and viaduct of a quarter of a mile in length, and of the extreme height of 70 feet. Mr. Stephenson proposes to pass through the hill of Penrhalt by cutting 1,000 yards in length and 17 feet in mean depth; and curving, with a moderate radius, to cross under the turnpike road and join the Menai bridge.

Mr. Giles, on proceeding from Penrhyn Park, recommends a more direct course than that of Mr. Stephenson, so as to bring his line nearly opposite to the end of the Menai bridge; but in adopting this plan, he would have to encounter very formidable difficulties, in the construction of two viaducts, and two tunnels, one of the latter being one mile and a quarter, and the other three quarters of a mile in length.

The passage of the Menai bridge is the next point of importance. It has been supposed that this would have presented an insuperable obstacle to the lines of Messrs. Stevenson and Giles, but neither of these gentlemen proposes to cross the bridge with locomotive engines; the former suggesting that the railway carriages may be drawn over by horses, and the latter by a stationary engine.

There seems to be no objection to either of these plans, and the loss of time consequent upon them would probably not exceed one quarter of an hour.

The following observations will show the sufficiency of the Menai bridge to sustain the weight of any number of railway-carriages that may be required to pass over it.

In the first place, as far as regards the mode of passage, no important difficulty can be foreseen; the only question therefore is one of strength.

The weight of a railway passenger carriage, with its load, is commonly estimated at about 5 tons, and the length occupied by each carriage, from one connecting pin to another, may be taken at 22 feet, when several carriages are in connection. This would give a pressure of only ·23 of a ton per lineal foot on the length of the bridge, supposing the platform to be wholly filled with such carriages.

Let us now see what weight the bridge is capable of sustaining.

It appears from the statement of Mr. Provis,* who was the resident engineer, during the erection of this splendid structure, that the suspended part between the piers consists—

	Tons.	cwt.
Of 16 main chains, including connecting plates, screws, bolts, &c., weighing - - - - - - - -	394	5
Of transverse ties, - - - - - - - - -	3	$16\frac{1}{2}$
And of suspended rods, platforms, &c., - - - -	245	$13\frac{1}{2}$
The total weight being, - - - - -	643	15

The distance between the points of suspension is 579 feet $10\frac{1}{2}$ inches, and the deflection 43 feet. With these data the tension, in terms of the weight may be readily computed, from the properties of the catenary curve! but it will perhaps be more satisfactory to derive it from the actual experiments of Mr. Rhodes, who superintended the erection of the chains, and who found, practically, the tension to amount to 1·7 times the weight. This makes the tension on the supporting chains from the weight of the structure alone, to amount to 1,094 tons.

Now to sustain this tension, we have a sectional area in the 16 chains of 260 square inches, which according to Mr. Barlow's experiments, made on the chain-cable testing machine at Woolwich, are capable of sustaining 2,600 tons, without injury to the elastic force of the iron, namely ten tons per square inch, the ultimate strength being 25 tons per square inch.†

	Tons.	
If then, from the absolute strength of the chains	2,600	
We deduct the strain due to the weight of the bridge, - - - - - - -	1,094	
There remains a surplus strength of	1,506	tons

which is competent, therefore, to sustain a uniform load (allowing the tension to be 1·7 times the weight) of $\frac{1506}{1\cdot7}$ or 886 tons. Now if the bridge were covered with loaded railway carriages on both sides, it would only be equivalent to 265 tons, leaving still a surplus strength of 621 tons. The objections, therefore, that have been raised respecting the capability of the bridge to bear the weight of the railway carriages which it might be required to support, must be considered as utterly groundless.

Mr. Stephenson proposes to establish a station at each end of the bridge, where the locomotive engines would be kept in readiness to be attached to the trains.

* See Mr. Provis's valuable work on the Construction of the Menai bridge.

† Mr. Barlow's Report to the Directors of the London and Birmingham railway.

AMERICAN RAILROAD JOURNAL, AND MECHANICS' MAGAZINE.

No. 5, Vol. V. New Series. | SEPTEMBER 1, 1840. | Whole No. 365. Vol. XI.

THE PENNY POSTAGE SYSTEM.

The great interest that this system, recently put into operation in England, is calling forth both there and on the Continent, renders it somewhat surprising that so little has been said about it in our own country. We have every reason to believe that the peculiar advantages resulting from it might with suitable modifications in the plan, be secured on its adoption in the United States. It has been thought by some, that there are sufficient reasons for its failure in this country, however successful it may be in England. We propose at present, to make some remarks upon what we consider as defective or improper in the English system, and next to answer such objections to the experiment with us, as appear most worthy of consideration.

It is needless to describe all the details of Rowland Hill's penny postage bill, or its modified form now in operation, these are of course, familiar to our readers. The chief peculiarities are. Firstly—the reduction of the postage to a sum so small, one penny Sterling, as to greatly increase the number of letters circulated—the charge for letters to any part of the Kingdom being the same. Secondly—the adoption of such arrangements as shall insure the payment in advance of all letters. It is supposed that the increased revenue from the greater number of letters, from the abolition of the franking privilege (which has hitherto been very extensive,) and from the prevention of all loss by dead letters, will more than counterbalance the diminution in the charge.

Simple and beautiful as this plan is in its outline, it has not been easy to carry into practice until encumbered with certain provisions and arrangements, which in our humble opinion materially detract from the grand object and excellence of the system—its perfect simplicity. The weight of the letter is no longer confined to the former limit (one ounce) but is allowed to go to *sixteen* ounces, an additional charge being made for

each extra ounce, and hence the necessity of weighing every letter beyond a certain weight. This provision has called into being a whole host of inventions, under the name of letter balances, some of them simple and accurate enough in operation, but all troublesome, in that they have to be used at all. We hope, in the event of an experiment on this side the Atlantic, that the ingenuity of our mechanics may be spared this test.

In order to secure the advance payment of letters, an envelope is used bearing certain authorised marks, etc., which envelopes are sold wholesale to stationers or others, by the post office, at one penny a piece, and thus the revenue is received in cash, some time in advance, and in large sums at once, dispensing in this manner with the services of many clerks.

This envelope is a somewhat lozenge shaped piece of paper folding but once over the letter and meeting with its four points where the wafer is to be attached on the back. The face is nearly covered with a design, which as a work of art, has rather humble pretensions. This is covered by several stamps and letters or numbers which are to be frequently changed, and upon it is likewise the address. We saw one not long since, and turned it over frequently, and did not notice, what we afterwards remembered was to be wrought into the envelope, sundry silken lines in the substance of the paper, but which were said greatly to resemble ordinary faint lines—being perfectly straight. On returning to the specimen we had examined, sure enough, there they were but not easily to be distinguished from ordinary faint lines, save by the touch, which showed them to be in the body of the paper.

These changes in the system have introduced several curious, and some of them sufficiently ludicrous practices. The extension of the weight of letters to sixteen ounces, has brought strange things into the letter bags. We learn from an article in the Mechanics' Magazine, that among them, were *goosebery bushes*, *monstrous cucumbers*, small *models of steam engines* and *leeches*. It further seems to have been found necessary to caution the public by an official notice, to be careful in enclosing *glass bottles*, and that a post-man has been indicted for stealing a *watch* out of a *letter*. It is almost needless to say that any regulation allowing of or encouraging such fantastical enclosures, does not appear to have been contemplated in the original plan, and should be banished from any judicious trial of the system with us.

The sale of envelopes by stationers has led to the following device. A respectable dealer offers for sale by the quantity, envelopes at *three farthings* each, for which he has paid the post office *one penny apiece*—or at a loss of one-fourth. The secret is this, the inside of the envelope contains an advertisement of certain articles for sale by the same dealer. A more excellent plan for an advertisement could hardly be found, as at least two persons are almost sure to read each one. It would be profitable even to give them away when used as a medium for advertising.

The attentive consideration of the difficulties under which our transat-

lantic brethren labor in the introduction of this system, may prove useful to us when we enter upon the experiment—at any rate we can draw upon their experience for answers to any objections against the system itself.

In the first place the most reasonable objection appears to be this, that the great extent of country in the United States, will render the cost of transporting letters so great, that a reduced postage will not cover the expenses of the department. To this it may be answered that the average distance of transportation bears no sort of relation to the surface of country, and will not in fact greatly exceed that existing in Great Britain. We think we are within bounds when we say that more than three-fourths of the letters leaving the city of New York, go no farther than Boston, Albany, Philadelphia or Baltimore. It cannot be conceived that the expenses on these letters, even under the present system will amount to two cents apiece, and when the improved plan is introduced a large portion of the individual trouble bestowed upon each letter will be very greatly diminished. In this event and with the increased circulation we may reasonably consider that these three-fourths will more than pay the cost of the remaining fourth even were the average distance as far as New Orleans. At present it is expected that the profits on short and heavy routes, will pay for the longer and less profitable. Again, it is to be remembered that when the expense of marking, charging and collecting on each letter is entirely done away with, letters will approximate more nearly to common freight, and it will readily be acknowledged that the charge of two cents per letter, will pay well enough on short routes, to cover any deficits from those of excessive length. It has never been considered desirable that the post office department should more than pay its expenses—the idea of making it a source of revenue, is preposterous—we had almost said.

The method of securing payment in advance, is considered as liable to many objections, the opportunity for forgery being thought very great. There are also those who think, that the many who are ever more mindful of names than things, would find their feelings so shocked by the idea of a *stamp* as to oppose a system introducing *stamped paper* and to visit upon its authors condign punishment. We propose to avoid this difficulty by the use of the word "*Frank*," a term by which no *freeman's* prejudices need be excited.

The use of adhesive franks, as proposed on in the original plan, strikes us as preferable to the envelope now in use in England.

Whatever method is adopted, the danger of forgery is not so great as is imagined. There is much more danger of bank notes being imitated because these are worth more, and yet the loss by counterfeiting is very small. In the case in point, however, the immense practice acquired in handling letters would give such a facility in detecting impositions as to render any loss by them almost impossible. We all know with how much readiness a receiving teller will detect a counterfeit, and there is no reason why a still greater degree of expertness might not be attained in the post

office. The public will in all cases be safe from fraud by purchasing only from respectable dealers. In fact we consider the difficulty of deception and the certainty of detection to be so great, as to render the multiplication of checks unnecessary.

Another plan has occurred to us, by which the difficulty might be removed. Let there be issued a 2 cent silver coin, passable as ordinary currency, and let this coin be attached by wax, or otherwise to each letter when thrown into the box. It is obvious, that without any charge for preparing envelopes or franks, the department receives payment in advance, in actual money and all that remains to be done is to remove it from the letter when examined. We confess that there are some difficulties attendant upon this plan, but they are such as could soon be overcome. The coin might, indeed, be a 2½ cent piece, or a quarter dime. A friend at our elbow, holding up to us one of the English "adhesive stamps" suggests the immeasurable superiority of a genuine "specie, hard money" currency, to "shin plasters" of any kind.

We believe that we have answered the chief objections to the penny postage system—but we cannot conclude our remarks without adding one advantage to the many and obvious benefits so frequently canvassed. We allude to the moral of the system. It is calculated to extend and continue friendships which under the present high rates of postage, are suffered to languish; it will become the means of associating the citizens of our country in close fellowship, promoting kindly feeling and doing away with sectional prejudice—it is in fact, offering to many of our citizens, a new sense—the hitherto unattainable means of communicating with friends at a distance.

The larger portion of letters now circulated, are sent by business men; but the reduction of the expense, would encourage intercommunication between those who have no worse reasons and may be, greater abilities to render others benefit by their letters. The rich will write more, and the poor still more, in proportion to their present correspondence. We know that many in their utilitarian views of matters and things will be inclined to dispise, and perhaps ridicule this last argument, but if such there are, they may laugh as much as they please—we candidly confess ourselves philanthropic enough to rejoice at the thought of the pleasure that will be afforded to thousands of hearts, by the introduction into our country of the "*Penny postage system.*"

Errata.—In our last number, the notice of Bedwell's gauge is confused by several errors. Page 105, line 11 from bottom, for "air pressure gauge," read "air pump gauge;" line 8 from bottom, for "three inches," read "thirty-one inches."

Pennsylvania and Ohio Cross Cut Canal.—The completion of this important work was celebrated with appropriate ceremonials on the 4th inst. by the citizens of Pennsylvania and Ohio. This canal runs from Beaver, Pa., on the Ohio river, to Akron, on the Ohio State Canal which connects Lake Erie with the Ohio river.

For the American Railroad Journal and Mechanics' Magazine.

Mr. Editor:—In turning over several works on the steam engine, for the purpose of ascertaining the precise amount of power derived from using steam of any given pressure on the "cut off" or expansive principl e have been surprized at the meagre details on this point. The only calculation I have found, is in a paper on the Cornish engines, which has several times been alluded to in your Journal. This calculation, however, seems to me to be erroneous, and although the mistake is not very great, yet it is proper enough to extirpate all error from calculations on this important subject. It seems to me that the matter is very plain, and how a mistake can have occurred does not easily appear. Permit me to explain my views of the question, and if I should be wrong, no one would be more happy to have the error pointed out than myself.

Let us in the first place examine into the subject, and then look at the quotation referred to.

Suppose steam of 10 pounds enters the cylinder, and is cut off at half stroke. Required the average pressure for the whole stroke. The following diagram will represent the pressure of the steam at different parts of the stroke, supposing A and B to be the ends of the cylinder.

A		$\frac{1}{2}$		B
	average pressure for 1st half 10		average pressure for 2nd half 7·5	
10		10		5

Thus the pressure is 10 pounds for the first half, and this same steam expanding to double its volume when it fills the cylinder, the pressure of 5 pounds is arrived at when the steam fills the whole cylinder, and only then, the average for the last half will therefore be 7·5 pounds, and the mean of the whole stroke $(10+7{\cdot}5)\frac{1}{2}=8{\cdot}75$ lbs. Now the calculation adopted in the paper mentioned above, and for all I know, the one generally used would be $(10+5)\frac{1}{2}=7{\cdot}5$ lbs. making a difference of one pound and a quarter or $12\frac{1}{2}$ per cent. of the original pressure.

Let us now turn to the paragraph above mentioned. It is as follows:

"Now supposing the admission of steam was cut off when the piston had travelled one-sixth of its stroke, the operation of its expansion, and the pressure at different stages, and mean pressure of the whole, will be seen by the following table.

	lbs. pres. per sq. in.
During $\frac{1}{6}$th of the stroke dense steam was admitted at a pressure of	17·25
At $\frac{2}{6}$th of the stroke the steam had expanded to twice its volume and the pressure was reduced to	8·62
At $\frac{3}{6}$th of the stroke, three times,	5·75
At $\frac{4}{6}$th of the stroke, four times,	4·31
At $\frac{5}{6}$th of the stroke, five times,	3·45
At $\frac{6}{6}$th of the stroke, six times,	2·87
	6)42·25
Mean pressure per square inch,	7·04

It might be supposed that the writer himself would have seen his mis-

take as he uses the word "During" and next "At," showing a perfectly correct statement but erroneous reasoning, therefrom. The diagram which follows will show the state of the case.

0		$\frac{1}{6}$		$\frac{2}{6}$		$\frac{3}{6}$		$\frac{4}{6}$		$\frac{5}{6}$		$\frac{6}{6}$
	av. pres. 17·25		av. pres. 12·93		av. pres. 7·18		av. pres. 5·03		av. pres. 3·88		av. pres. 3·16	
17·25		17·25		8·62		5·75		4·31		3·45		2·37

By taking the mean of these several average pressures, it will be found to be 8·24, giving 1·2 lb. more than the pressure calculated in the paper.

I feel the great necessity of caution, in pronouncing this to be an error, because it would appear from some remarks of the writer that Watt had made the same mistake, and he certainly would not be likely to fall into error. Not having access to his own calculations, however, I am inclined to think that he has been misquoted.

The true mode of calculating, then, is, to obtain the average pressure of each portion of the length of stroke, and then take the mean of the quantities thus obtained. The process at first appears rather complicated, but the following rule, it is believed will simplify it as much as possible.

Rule.—Find the pressure of the steam at each fraction of the length (as in the case above at 0, $\frac{1}{6}$, to $\frac{6}{6}$,) add the first and last together, divide by two and add this quotient to the sum of the remaining numbers. This sum divided by the number of parts (6 in the case above,) will give the true average.

The importance of a true expression of the power when steam is used expansively, renders it somewhat remarkable that no notice should before have been made of this error. As I said before, if any of your readers can prove that I am wrong I should be most happy to acknowledge myself so, if the true solution is given by any one else. II

To the Editors of the American Railroad Journal and Mechanics' Magazine.

It has long been known, that a fluid of any description running from an orifice in a vessel, whether at the side or the bottom, into the atmosphere, is more obstructed than it should be legitimately by the mere pressure of the latter. It also is known, that if this fluid thus issuing is made to pass through an abconic tube—the outer end being the largest, it will leave the vessel in greater abundance than it ought to do, pursuant to the laws of falling bodies. Newton made experiments upon those facts, but he did not perceive the cause. Nor has that cause ever been given. I have recently discovered it. Nor is it very occult. It is to be found in the *elasticity* of the atmosphere. I have made a drawing to demonstrate this, but could not stop there, and do what I considered to be justice to myself and the subject; for, in turning over the pages of the American and Franklin Journals of Science, I found many instances where the same principle was involved, while the writer of the article in which it was so, knew nothing about it. My remarks upon these articles extended my own to about twen-

ty pages, and too far for this Journal and perhaps too far any one. I am therefore under the painful necessity of leaving the dynamicians of the age to tell us how it is that the *elasticity* of the air opperates against the spouting fluid in the one case, and in favor of it in other.

It is said that the velocity of any wave is equal to that which a body would acquire in falling through half the depth of the fluid in which such wave is found, but I have not seen the demonstration, and do not succeed in perciving the truth of the proposition. I wish it could appear in some of our scientific Journals.

It is known that the first or perhaps the second tide after the syzygy is greater than is that which occurs at the time of this conjunction or opposition of the sun and moon; and in explanation of this phenomeny we are told in general terms that the tide we have one day was raised the day previous. But this is not *strictly* true. The expression conveys a wrong idea; but to show what is correct in this case would require more diagrams than would be suitable for this Journal. This point, then, I must leave to dynamicians.

It is said there is no lunar tide at the Sandwich Islands. Let us know for a certainty whether the fact is so or not—and then we shall be in season to attempt to assign the eause.

Alterations for the synopsy of Botany which appeared in the last number of this Journal. Immediately above *Nomastephanies* insert *Corticalutas*, dirca ; and above *Nomexogenes*, insert *Sacarinarbors*, maple. The Endogenas are thus arranged; 1st the *Palmates*, and 2nd the *Musates*, which are spathate; 3d the *Nomendogenas* which include all that have a corol distinct from the calyce; 4th the *Liliates* will embrace those except the orchidates whose calyce and corol are confounded; 5th the *Orchidates*, will consist of the labiates; 6th the *Cormocockles*, screwstem, and 7th *Typhates* have a spadica without a spathe, but they are easily distinguished from each other; 8th, the *Arumites* have a spadica and spathe; 9th, the *Helosites*, or belanophors; 10th, the *Juncaginates;* 11th, the *Fluvials* and 12th, the *Pistiates* are all easily distinguished from the others; and these groupes may be spoken of as primary ones without any confusion, because neither is included in any other one; and thus we shall have *sixty-five* classes of vegetals proper. And to the question, should it be asked, why we do not make every natural order of botanists a class, our answer is, we cannot distinguish them by any obvious character to the common observer. The *Ulmutes* and *Tiliates*, would be the next ones, that we should attempt to distinguish, but we leave them for the present.

Say of the Artocarpics, that they are *Apogynandrous* and sometimes *Alophytandrous.*

Of the Spermagonics, that they are occasionally Alophytandrous. This, remember is said of the plants. Of the Stamins, we should say, they are *Alophytous*, *Apogynous*, *Apogynautophytous*, etc. This last term you will say is long; but it is no more so than Monoecious-diclinous, for which it is

substituted; and besides, the old terms which you will perceive I have laid aside, are applicable not to the plant nor even to the stamins alone, but only to the stamins and pistils taken together as one entire group. By adopting these terms I have carried out the nomenclature which botanists have already adopted; so that stamins are now Hypogynous, Prigynous, Epigynous, Apogynous; and the plants are Syngynanders, Apogynanders, (polygamous) Allophytanders and Apogynautophytanders. This term is no longer, and more euphonous, than is unconstitutionality.

Say that the stamins of the Malvates and the anthers of the Composites are *Synemenous*, and that the Malvates themselves are *Synemenandrous* and the Composites *Synemenantherous*. The old terms are all a disgrace to botany, and an outrage upon the Greek language.

Oliver Smith.

For the American Railroad Journal and Mechanics' Magazine.

I have waited for several weeks, since the communication on page 4, in order to hear all that others might say on the subject of "Crank Motion." As there appears to be a cessation on their part I will proceed, and endeavor to sustain the positions taken in my former article, page 324.

From the communication page 4, it will be seen that the author has yielded the point in dispute and now grants that there is no loss from the crank except extra friction.

There would be no need of referring to his paper, except that from his peculiar style it might appear that I had made a gratuitous attack upon one who always thought with myself. I shall not however undertake to refute any of his positions since he allows the main point; but merely suggest a few questions for the reader's consideration, and at the same time request him to examine my remarks as well as the comments, in case the author should favor us with another critique.

1. Why is the author "particularly called upon" and "strictly required" to answer communications on the theory of the *Crank*, because he has written on *Locomotives?*

2. Why does he suppose his works on the locomotive to be the objects of attack when no one but himself has referred to them?

3. Why does he say respecting myself "which I presume he finds necessary to support the vagary of a perpetuum mobile into which he had sophisticated himself," when I used the acknowledged impossibility of a perpetual motion, to prove his views erroneous, as they led directly to this result?

4. Why does he call my expression "p=P sec. d," a "profound absurdity," and propose as a substitute "p=P cos. d? Is he ready to maintain the accuracy of his expression when applied to the thrust of a rafter or an arch, and to say that as the roof or the arch flattens the thrust is diminished, and when the angle d(="the angle of departure of the rod from the line of the original direction of the power") becomes almost a right angle, and

consequently the rafters or the arch nearly horizontal, then (the force $p=$ "the force in the direction of the rod," or in the case of a roof or an arch) the diagonal thrust becomes almost nothing?

5. Can he show "a more wonderful affair than even a perpetual motion?"

6. Can he show a "profound absurdity" in the conclusion that when the angle d is nearly a right angle, "the force upon [of?] the piston would be multiplied to an unlimited extent." Or in the case of an arch (supposing all the weight in the keystone to make the case precisely similar,) is it absurd to say that the thrust becomes infinitely great as the arch is infinitely near a straight line?

7. Can he show the necessity of "combining several connecting rods" to increase a force already granted to be unlimited from the use of a single one?

8. Can he show that a "power quite unlimited might be *created*" because the force becomes infinitely great when its virtual velocity becomes infinitely small?

9. Can he show that under these circumstances "an animalcule might be substituted for the gigantic power which men have hitherto found it necessary to employ?

10. Can he show that p is a maximum at the dead points, and in all other positions always less than P?

11. Can we call his unsupported objection to the proposition

$V : v :: \sin. c : R$, an argument?

12. Can he show the necessity of referring to *his* paper to prove that a passing remark in *mine* was "mere assertion," when I stated distinctly that "this practical demonstration is too long and intricate for the present article?"

13. Can he inform us, how, without "calculation" but from "purely numerical statements of the results of experiment," we can ascertain whether there be, or be not, a loss from the crank?

14. Can he inform us what are the "reserved privileges" of an individual, who, when arguing a scientific point, breakes through the rules of debate, and resorts to personalities and harsh expressions? Or does he expect to cover his retreat from an untenable position, by using towards myself and others, such terms as "absurd estimate; fallacious reasoning from absurd premises; errant and gratuitous assertions; verbal sophistry; vagary of a perpetuum mobile, into which he has sophisticated himself; very little skill or very little caution; profound absurdity; more wonderful affair than even a perpetual motion; of course chimerical, and the result of incorrect analysis; castles airy; tilt Quixotic; tumble into a promiscuous chaos of cloud and vapor?"

15. Can he reconcile his present remark "that its effect." (*i. e.* the crank) "was included with the utmost precision in the item friction," with the whole tenor of his former communication, from which I need only extract the following. "For let it be observed that this resistance of an unloaded

engine is *incorrectly* named when designated *friction.* It is indeed a compound result, including within it the effect of the crank; and is in fact the friction proper to all the rubbing parts of an engine, increased in the *ratio of loss from crank motion?*

16. Finally.—Can he show that I have not put a fair construction on his expressions, or that there is any discrepancy between this paper and my former communication? In his own communication, can he show an argument that is not an error?

The next communication is on page 36.

In this the author by a different process arrives at the same point with myself and shows that there is no theoretical loss from the crank. It therefore requires no comment.

In the third communication, page 66, the author objects to my views. He says:

"If we could change a rotary motion into a straight motion without applying a straight motion we could accumulate power. But since this is impracticable, and since a rotary motion produced by a previous straight motion causes a *loss* of as much useful power as the change from a rotary motion into a straight motion will cause a *gain* of useful power, the loss will balance the gain during the action of the machine, and there can therefore be no accumulation of power; hence no chance of a perpetual motion."

If we cause the crank to revolve by being attached to a drum, and this drum to be moved by means of a cord acting on the circumference, and to which the power is applied, we convert a rectilinear into a circular motion without loss. If we then, by means of the crank convert this circular into a rectilinear motion, we gain power according to the above hypothesis. We have therefore a gain without a loss; and the effect must be greater than the cause, which is impossible.

Again. "The principle I contend for is, that when a body has received an impulse of motion, this impulse will continue to operate in the same direction unless the course of motion is checked" [changed?] "and if then the force of the impulse be not allowed to develope itself freely, the momentum of the impulse will lose some power."

I have substituted *changed* for "checked" which I presume has been used as its synonyme for if construed strictly it would be a *petitio principii,* since no one can deny but that if the motion be checked, there will be a loss.

Now I not only deny that there must necessarily be a loss when a rectilinear is converted into a circular motion, but I assert that the curve may be of any description, and even that the motion may be angular without a loss of power or momentum, or a consumption of the power of the diverting force.

If the diverting force be constant, the motion will be curved, but if intermitted it will be angular. It makes no difference whether this force act

internally by attraction as in the case of gravity or of a body attached to a string and revolving around a centre; or whether externally by refulsion as in the case of a surface of different directions whether curved or angular, supposing it to remain fixed.

For take the extreme case of a hard body striking a plane nearly at right angles; its new direction mnst be that of the plane, for the body not being elastic it has within itself no resilience that would cause it to leave the plane, and the plane itself being fixed, cannot throw it off. The angle formed by the course of the body would therefore be nearly a right angle, but still there would be no loss of power. For, whatever the force against the plane, it is inert since no motion is communicated, consequently the plane receives no momentum. Since power or momentum can not be absolutely lost, we must find it somewhere, and since the plane receives none, it must remain undiminished in the moving body. Thus, the plane effects this change without loss to the moving body. But the plane itself does not move, therefore no power is expended by the diverting force.

This case includes that of curves. In ordinary practice we cannot prove this to be strictly the case, for we cannot find resistances that are positively fixed, and without friction, nor bodies that will not alter their form. But in the case of the heavenly bodies these natural obstacles do not interfere, and in their undiminished average velocities we have a practical demonstration that the initial momentum is not lost by a change of direction.

Again: The anthor objects to the proportion.

$$V : v :: \sin c : R$$

and says, "It will be agreed on that the respective velocities of the prime mover, and of the crank pin, are as the spaces through which they have actually moved."

I can by no means agree to this proposition. When the prime mover has a uniform velocity the crank pin moves with every velocity from infinitely great, diminishing constantly to unity. This being the case, the average velocity of the pin must at every position of the pin, (in the first and third, while the reverse is the case in the second and fourth quadrant) have been greater than at the moment we would compare their respective velocities. These respective velocities are not as the spaces through which they have moved, but through which they are moving for an instant, and are constantly changing, and as I maintain are correctly expressed by the proportion to which the gentleman objects.

Refer to the diagram, page 326, last volume. The pin being at P, its direction for the moment is DP. Had its direction from the commencement been the same, it would have moved from D to P, while the power acting in parallel lines would have descended from D to A. Therefore,

$$V : v :: DA : DP \text{ or}$$
$$V : v :: \sin c : R$$

That the pin does not actually move from D to P is a matter of no consequence since it is not spaces but proportions that we are seeking.

Again, I can not grant as a legitimate conclusion from the above that "the following should also be right.

$$\text{Versin } c : \text{arc } c :: \sin c : R\text{''}$$

since neither the versin nor the arc have any relation to the proportion I have used, nor yet to the respective velocities; as I have already shown.

But what are we to understand from the remarks on this proportion taken in connexion with the two above it on the same page?

As I understand the gentleman he says the following is correct:

$$V : v :: \text{sin verse } c : \text{arc } c$$

but subsequently he says that "the verse sine can bear no definite relation to an arc." Does he then mean that the respective velocities of the prime mover and of the crank pin can have no definite relation to each other? This I think must be the conclusion.

But I deny the accuracy of the last proportion; for when V is constant v is infinitely great at the moment it has passed the dead point. Therefore the arc c must at times be infinitely greater than the ver sin c. As this is never the case the proportion can not be correct. Consequently the reductio ad absurdum fails for want of premises, and my positive demonstration remains untouched.

I thus come to the conclusion that whether the position I have taken respecting the crank, be true or false, nothing has yet appeared that convicts me of error.

Yours respectfully,

B. Aycrigg.

PARLIAMENTARY RULES.

In all deliberative assemblies, a presiding officer is found necessary to preserve order among the disputants and prevent their resorting to personalities and irritating expressions.

It appears to me that the same arrangement is necessary in a journal in which arguments are carried on in print. The editor should perform the duties of moderator, and all objectionable articles should be returned to their authors until so modified as to be strictly in accordance with parliamentary rules.

Error and truth are the only questions of importance to the public, and to them it makes no difference whether promulgated by a Newton or an idiot.

That one writer objects to the investigations of another is no ground of ill feeling between the individuals. The best mathematicians sometimes commit errors, and a "fool may now and then be right by chance." But whatever a writer may *feel*, I think that no one should be allowed to use such expressions as "absurd premises," "absurd estimate" "profound

absurdity," &c. &c. If he *can* let him *prove* an error, and if the error be really *absurd* the reader can apply the epithet without seeing it in print.

Yours respectfully,

B. Aycrigg.

In regard to the foregoing remarks we have a few words to say for ourselves. It is a delicate matter to interfere with the communications of correspondents, yet this would never deter us from doing our duty in expunging expressions evidently improper, but then the difficulty lies in defining wherein impropriety exists. In the case before us, however, the truth is, that relying upon the courtesy of the parties concerned we never bestowed that care upon the articles when received, which the present turn of the discussion shows to have been really necessary. We recollect with great pleasure one case, in which a timely arrest of a hasty but unwarranted personality, brought the parties to a mutual understanding, convinced those in error, and brought about a personal acquaintance.

There has always been a slight difference of opinion with the proprietors in regard to the line of demarcation, but none whatever as regards absolute personal abuse; if such has ever crept in, it has been by one of the thousand accidents by which, in the management of a periodical, things are said and done unintentionally, and sometimes without the knowledge of the conductors.

Col. Aycrigg deserves our thanks for keeping his temper after feeling himself agrieved, but we are very sorry that he or any one else who can maintain such a good natured bearing, should have been deterred from entering into a discussion which that very good nature might have softened into a friendly exchange of sentiments.

American Engines in England.—We are glad to learn that American mechanical genius is appreciated in England, and that for the immense amount of railroad iron which the United States has received from Great Britain, the latter country is receiving from the former, in part payment, many excellent locomotive steam engines for her own railroads. The subjoined is part of a letter from a friend in Liverpool, written on the 3d of June:

In answer to your inquiries as to the locomotives shipped to this country, by your enterprising citizen, William Norris, under contract with some of our railroad companies, I am happy to say that they have succeeded to admiration. Some delay arose in testing some of them, arising from the circumstance of his head engineer, or manager, on this side the water, having, on two occasions been detained on the continent, by Mr. Norris' business there, longer than he calculated on; and nothing could be done in the trials of the engines in his absence. Every thing has resulted very satisfactorily, and all his engines have been promptly paid for, except the last, which was shipped in April, and is of the largest class, which is now on trial—and his agent tells me that the trial is nearly completed to perfect satisfaction—and which the company will pay for in less than ten days. I am further informed that all of Mr. Norris's engines give perfect satisfaction, and that orders have recently been sent him for four additional ones.

RESISTANCE TO RAILWAY TRAINS.—*Dr. Lardner recently delivered a course of Lectures "On the resistance of railway trains, the effects of gradients, and the general economy of steam power."*

LECTURE I.

Dr. Lardner commenced by observing, that it was a strong example of the manner in which practical matters were conducted in this country, that they had been now ten years, with all the extraordinary effects of railways passing under their notice, stimulating their attention and calling up the wonder of all parts of Europe, and yet to this hour the general problem, the solution of which was the actual amount of resistance to railway trains, might be considered to remain, so far as the engineering profession was concerned, without solution.

It was not till a very recent period that, even on common roads, the amount of this resistance had been made the subject of inquiry. An instrument, had, however, been invented by Mr. M'Neil, the engineer, who had instituted experiments to ascertain the actual resistance on turnpike roads, which he had found to be about one thirtieth part of the load. Now the principle was equally applicable to common roads as to railways, that the resistance would be diminished in the proportion in which they enlarged the wheel; but when they increased the size, they also increased the weight, so that there was a practical limit to the diminishing of resistance in this manner. The average resistance which a load placed on a railway afforded to the tractive power, was intimately connected with the principle upon which railways themselves were constructed; and this connection had been largely acted upon by the legislature in inquiries concerning contested railway bills. It had been assumed in parliament that an engine might be expected to pull a load, with all the necessary expedition, up an inclined plane, provided that inclined plane offered not more than double the resistance which an engine had opposed to it on a level. That had been laid down and acted on in parliament as a species of standing order. The principle acted upon was, that the resistance upon a level would be about 9lbs. a ton, and, consequently, an inclination which resisted 1 in 250, was an inclination up which the engine might be expected to work with a full speed. Upon this principle the sections of all the railways in the country had been laid. But the fact was, that the resistance depended upon entirely different principles. In the inquiries which took place, no one ever hinted that the resistance depended upon the speed—no one suspected for a moment that there was more resistance at thirty miles an hour than at one mile an hour. He was quite sure that many would be perfectly astonished at this statement, but it was a fact established by abundant evidence, and innumerable experiments made by philosophers at different times and in different countries, that resistance depended upon friction, and did not depend upon speed; that so far as resistance to any degree depends upon the friction of the axles upon their bearings, or the rolling motion of the ties upon the road, it was demonstrable that the resistance was the same at all speeds whatever, whether twenty, thirty, forty, or fifty miles an hour. Never supposing that there was any other cause, they at once assumed that resistance, at all speeds, was either actually or nearly the same. This was the source of the error.

One of the standing orders of parliament was, that whenever a railway had a curve, with a radius of less than a mile. the committee must make a special report of such a curve, upon the supposition that it was attended with increased resistance or danger. The popular idea was, that when the wheels got to the curve, the outer flange of the wheel mounted upon the rail, by the conical form of the tyre, while the other fell from off the rail;

thus the one wheel acquired a diameter virtually greater than the other; that, therefore, one revolution of the outer wheel, having a virtually greater diamater, would carry it over a greater space than one revolution of the inner wheel; and that the two things would accommodate each other so that the outer wheel gets over a larger portion of the rail, while the inner wheel, being virtually smaller, gets over a smaller space, and that in this way the cone of the wheel accomplished the thing. Never was there a more consumate mechanical blunder. The fact was, the cone had nothing to do with the traversing of the carriage round the curve; and it was entirely the mechanical action of the flange pressing on the rails.

He had alluded to one or more circumstances connected with the practicable and probable speed likely to be attained on railways, and the means by which that speed might be attained. Since the great questions which had been agitated respecting the effect which an increased witdth of rails would have on railway transit, and the effect which very large drawing wheels, of great diameter, would have on certain railways, the question of very vastly increased speed had acquired considerable interest. Very recently, two experiments had been made, attended with most surprising results. One was the case of the Monmouth express. A despatch was carried from Twyford, to London on the Great Western railway, a distance of thirty miles, in thirty-five minutes. This distance was traversed very favorably, and being subject to less of those casual interruptions to which a longer trip would be liable, it was performed at the rate of six miles in seven minutes, or six-sevenths of a mile in one minute, or 360-7ths of a mile (very nearly $51\frac{1}{2}$ miles,) an hour. He had experimented on speed very largely on most of the railways of the country, and he had never personally witnessed that speed. The evaporating power of those engines was enormous. Another performance, which he had ascertained since he arrived in this neighborhood, showed that great as the one just mentioned, they must not ascribe it to any peculiar circumstance attending the large engines and wide gauge of the Great Western railway. An express was despatched some time since from Liverpool to Birmingham, and its speed was stated in the papers. One engine, with its tender, went from Liverpool, or rather from the top of the tunnel at Edge Hill, to Birmingham, in two hours and thirty-five minutes. But he had inquired into the circumstances of that trip, and it appeared that the time the engine was actually in motion, after deducting a variety of stoppages, was only one hour and fifty minutes, in traversing ninety-seven miles. The feat on the Great Western was performed on a dead level, while, on the Grand Junction, the engine first encountered the Whiston incline, where the line rises 1 in 96 for a mile and a half; and after passing Crewe, it encountered a plane of three miles to the Madeley summit, rising 20 feet a mile, succeeded by another plane, for three miles more, rising 30 feet a mile; yet, with all these impediments, it performed the ninety-seven miles in one hour and fifty minutes, or 110 minutes; consequently the distance traversed in each minute was 97 divided by 110, or $52\frac{10}{11}$, nearly 53 miles an hour—a speed which, he confessed, if he had not evidence of it, he could scarcely have believed to be within the bounds of mechanical possibility. The engine which performed this feat, had driving wheels of $5\frac{1}{2}$ feet diameter; their circumference would be $17\frac{1}{4}$ feet. Taking the speed at 53 miles an hour, it was within a very minute fraction of 80 feet in a second of time. This was not the greatest speed of the engine, but the average speed spread over 97 miles, and there could be but little doubt that it could have exceeded sixty miles an hour during a considerable portion of the distance. Dr. Lardner concluded by saying, "there was as yet nothing to satisfy us that a much greater speed was at-

tainable by the adoption of the very large scale or gauge of railway which had been thought desirable by those who were interested in the Great Western Line."

Lecture II.

In this lecture the Doctor directed attention to a remarkable line of distinction which existed between inclinations upon railways of different kinds. If, for instance, they had a gradient which would fall at the rate of one foot in a thousand, the train would not roll down, because the gravitation would be insufficient to overcome the mechanical resistance. But suppose the acclivity were increased, so that the gravitation would just balance the friction, that inclination would be what in mechanics was called the angle of repose. The amount of this inclination had been made the subject of much dispute; but it had been generally assumed that it had been at the rate of 1 in 250, or at the rate of about twenty feet in the mile. Any inclination greater than this would cause the train to move down spontaneously; and it had been assumed in railway investigations before committees of parliament, that the train, under such circumstances, would double its velocity every second of time. The inevitable conclusion to be drawn from this was, that if they had a steep inclined plane of sufficient length, the consequence would be an indefinite increase of speed, till they had actually acquired a velocity of 1000 miles an hour. Now, they would after this hardly credit the results which actual experiment gave. Nothing could be easier than the problem to determine the actual resistance from the motion of trains on railways, because it was a matter of easy mathematical calculation to predict what the volocity acquired at the end of the first minute would be, and, according to the rule laid down, that it would be twice as great at the end of the second minute, and so on. By comparing this with the velocity the train actually acquired, the comparison would furnish them with an easy clue. Upon this principle, Dr. Lardner had proceeded in a series of experiments made on the Whiston Plane, which has a fall of 1 in 96. They had four coaches, the gross weight of which was 15½ tons, and these coaches were propelled along the summit level to the brink of the plane, until a velocity of 29 miles an hour was given to them, and then the engine was detached, leaving them to move down. By means of stakes placed on the side of the line, they were enabled to register the length of time it took to descend every successive 110 yards. They commenced their descent from the summit of the plane at a velocity of nearly thirty miles an hour, which, in a very short space of time, increased to 31¼ miles an hour, and then they found that gravity could do no more for them. Instead of going at the frightful velocity anticipated by parliament, they found they got into the most uniform rate of motion at the third or fourth stake, after which there was no increase of velocity whatsoever; and at this uniform motion they continued to descend till they reached the end of the plane. They submitted this experiment to all possible tests, by increasing the weight of the carriages to 18 tons, but it only gave them an increased velocity at starting of 33¾ miles, the train descending at a uniform speed the remainder of the distance.

Upon these experiments Dr. Lardner proceeded to remark—"There is an important thing connected with this, which I will briefly explain to you. The force that moves the train down an inclined plane is, as you will see, the gravitation of the weight of the train down the plane. This gravitation would, until altogether balanced by some resisting force, acquire an accelerated motion. So long as the resistance to the descending train is less

than the gravitation down the plane, so long will the excess of gravitating force down the plane produce an acceleration of velocity, be it more or less. But as soon as the resistance becomes equal to the gravitating force, then there will no longer be any acceleration; the train will no longer acquire an increasing speed. On the other hand, it will not loose speed; if it did, then the inference would be, that the retarding force exceeded the gravitation: but they acquire an equilibrium, and as soon as the resisting force increases to that point that it is exactly equal to the gravitation, then the motion is uniform. The inference we deduced, therefore, was this:—that at $31\frac{8}{10}$ miles an hour, the gravitation of this train down the plane of 1 in 96, was equal to the resistance; in other words that the resistance to that speed was $\frac{1}{96}$ part of the weight. And you will see that a necessary consequence of this is, that a train of equal weight, placed on a level, and drawn along a level at the same speed of $31\frac{1}{4}$ miles an hour, the resistance which it would oppose to the moving power would be $\frac{1}{96}$ part of the whole load. This alone will show you the extent of the error which these experiments exposed; for the common notion before was, that the resistance in all cases was $\frac{1}{250}$ part of the load, about 9 lbs pr tn. whereas it appeared that it was in this case $\frac{1}{96}$ part of the load, or about 23 lbs pr tn. so that the engineer's estimate would be in error to the inconceivable extent of mistaking resistance of 23 lbs. for a resistance of 9lbs per ton."

Dr. Lardner stated that he had tried similar experiments on the plane of the Grand Junction Railway, which descends from Madeley towards Crewe, at the rate of 1 in 177 for three miles; afterwards descending at the rate of 1 in 265, followed by another descent of 1 in 330. The coaches loaded at 18 tons were moved down this plane in exactly the same way, the wind being fair, and they got a velocity of $21\frac{1}{4}$ miles an hour, and with this velocity they continued to descend the three planes. On making inquiries of the engineman, he found that the steam was never cut off in descending these planes, so that, instead of accelerating the engines at a dangergous speed, as was anticipated by the parliamentary committee, they were actually insufficient to propel them at a sufficient speed for the work of the road. The result of all the experiments he made on the Madeley plane was, that he never met with an instance of propelling trains down, with a fair wind, at a speed of more than 23 miles an hour. From a comparison of the experiments made at the Madeley and Whiston planes, Dr. Lardner said, "I made a calculation, from which it appears that in the first experiment of the two trains, that portion of the resistance which is due to friction amounted to 96 lbs. only, while that which is due to the atmosphere amounted 268 pounds. In the second experiment, with 18 tons, the portion of resistance due to mechanical causes amounts to 100lbs., while that which arises from the atmosphere amounts to 321 lbs., at only 33 miles an hour. One of the objections was, that the train was too light, and that no fair inference could be drawn from four carriages. We, therefore tried trains of six and eight carriages. Several experiments were made down very steep planes—that of Whiston being 1 in 96, and that of Sutton 1 in 89. In the first experiment of six carriages, the wind was against us. Down the plane of 1 in 89, we could not get more speed than $32\frac{1}{3}$ miles an hour. At this speed the resistance was equal to the gravitation. But with the wind favorable down the same plane, we got $37\frac{1}{2}$ miles an hour, and a mean of these two would be about 35 miles an hour. On the Whiston plane, 1 in 96, with the wind adverse to us, we only got $27\frac{8}{10}$, or nearly 28 miles an hour, but with the wind favorable, we got 34 miles an hour, the mean of these being about 31. In both these cases, both on the Sutton and Whiston planes, you see the evident effects of the wind. The mean of the two, in these cases, gives, on

a less steep plane, a less velocity than on a steeper plane the mean did in the other cases. It is remarkable, and very satisfactory in confirmation of the former experiment, that we had six carriages in a calm descending the Sutton plane, and what was our uniform speed? $35\frac{1}{3}$ miles an hour, the atmosphere being calm. In two other cases down the same plane, with adverse wind, we got a speed of $32\frac{1}{3}$ miles an hour; with favorable wind, $37\frac{1}{2}$ miles, the mean of which is $35\frac{1}{2}$ miles; so that in a calm we got a mean between the speed with a favorable, and that with an adverse wind. All these harmonies in the results are so many corroborations of the principle which they develope."

Lecture III.

In this lecture the Doctor explained a variety of experiments made on railways, in order to ascertain the source of resistance. He found that an enlarged temporary frontage constructed with boards, of probably double the magnitude of the ordinary front of the train, caused an increase of resistance. Seeing that the source of resistance, so far as the air was concerned, was not to be ascribed to the form or magnitude of the front, it next occurred to him to inquire whether it might not arise from the general magnitude of the train front, ends, top and all. An experiment was made to test this; a train of wagons was prepared with temporary sides and ends, so as to represent for all practical purposes, a train of carriages, which was moved from the summit of a series of inclined planes, by gravity, till it was brought to rest; it was next moved down with the high sides and ends laid flat on the platform of the wagons, and the result was very remarkable. The whole frontage of the latter, including the wheels and every thing, a complete transverse section of the wagons, measured 24 feet square, and with the sides and ends up, so as to present a cross section, it amounted to nearly 48 square feet. The uniform velocity attained on a plane of 1 in 177, without the sides up, was nearly 23 miles an hour; whereas, with the sides up, it was only 17 miles an hour; so that, as the resistance would be in proportion to the square of the velocity, other things being the same, there would be a very considersble difference, due to that difference of velocity. Then, at the foot of the second plane, while the sides were down, an undiminished velocity remained of $19\frac{1}{2}$ miles an hour, whereas, with the sides up, it was reduced to $8\frac{1}{2}$ miles an hour; so that a very extensive difference was produced. They would see at once, that this was a very decisive experiment to prove that the great source of resistance was to be found in the bulk, and not the mere section or the form, whether of the front or the back of a train; but simply in the general bulk of the body carried through the air. It was very likely to arise from the successive displacements of a quantity of the atmosphere equal to the bulk of the body; or still more probably, from the fact of the extensive sides of the train; and indeed there was little doubt that the magnitude of the sides had a very material infinence; for, if they consider what is going on in the body of air extending from either side of a train of coaches, they would soon see what a mechanical power must be exercised upon it. Thus, when a train is moving rapidly, the moving power had not only to pull the train on, but it had to drag a succession of columns of air, at different velocities, one outside the other, to a considerable extent outside the train; and it did more, for it overcame their friction one upon the other; for as these columns of air were at different velocities, the one would be rubbing against the other; and all this the moving power had to encounter. This would go far to explain the great magnitude of resistance found, and its entire discordance with any thing previously suspected.

Dr. Lardner next proceeded to consider the practical bearings which the

experiments he had detailed would have on the construction of railways. From these experiments a two-fold fact was deducible: first, there was unquestionably a great amount of resistance, and secondly, this resistance had a material dependence on the velocity; it diminished in a very rapid proportion as the speed was diminished. If, therefore, by slackening the speed, they could relieve the engine from any considerable portion of the resistance opposed to it, they had at once a ground for throwing overboard all the objections which had been raised against sections of railways which had considerable gradients. It was asserted that the resistance was a resistance quite independent of the speed, and that its average amount was quite equal to the gravity down a plane with a fall of twenty feet a mile. Both propositions had proved to be false. The resistance was not constant; it depended on the speed, and its average amount was equal to a great deal more than twenty feet a mile. The gradient that represented the average resistance, instead of being twenty feet a mile, was probably fifty feet; and instead of having no power of limiting the speed they had a power to which there was scarcely a practical limit. The lecturer stated that he had been ridiculed for the opinion he had advanced before the committee of the House of Commons, that the Southampton railway section, of twenty feet to the mile, was as practically good as that of the Great Western, which was on a dead level. He had made that assertion on the ground that in the descent there would be as much advantage gained as disadvantage to be encountered in the ascent; and, except the inconvenience which would result from the inequality of speed, being at one time fast, and at another time slow, there would be no other inconvenience or disadvantage worth mentioning. And, therefore, he did contend, that it was an extremely improvident and unwise expenditure to lavish millions in cutting through elevations and filling up valleys by large embankments, and constructing tunnels and viaducts, and all the other expensive works, to obtain a dead level. Experiments had since been made, which proved the conclusions he had arrived at to be substantially correct. These experiments had been made by Mr. Wood, the engineer of the Liverpool and Manchester railway, on the Grand Junction line. A train of twelve carriages, each weighing five tons, was attached to the *Hecla* engine, the gross load being about 82 tons. This was started from Liverpool to Birmingham, under peculiarly favorable circumstances as regarded the calmness of the day and the state of the weather, the engine being allowed to do its own work, unassisted on the various inclines; the velocity of speed throughout the whole way from Liverpool to Birmingham and back again from Birmingham to Liverpool, was, of course, accurately ascertained, and if the theory which he had endeavored to develope was correct, they ought to find that the average speed in ascending and descending the inclinations would be nearly equal to the speed they obtained on level parts of the line. There were several planes along the line, and taking the steepest first, viz. 1 in 177, they ascended that plane at the uniform velocity of $22\frac{1}{4}$ miles an hour, and descended it at the rate of $41\frac{1}{2}$ miles an hour, the average being as nearly as possible, $31\frac{3}{4}$ in ascending and descending. The ascent and descent of the other gradients on the line gave the same, or very nearly the same, results—the average speed varying little from 31 miles an hour. There was a considerable portion of the line level, and the speed upon that portion was 31 miles, being just the same, allowing for inevitable small discrepancies, as the average speed upon the inclines up and down the line. The plain inference which Dr. Lardner drew from these experiments was this: that the trains between Liverpool and Birmingham performed their journeys in just as short a time as they would do if the line was a dead level from terminus to terminus. He, therefore, considered it unadvisable, to expend money in attaining very flat sec-

tions, gradients not exceeding thirty feet a mile being, in his opinion, practically as good as a flat and dead level.

Dr. Lardner next observed that it was inexpedient to lavish money in avoiding curves of a less radius than a mile as no danger could, he believed, attend a curve having a radius of half a mile, perhaps less. It was, likewise, apparent that it was useless to lavish capital on expedients for greatly diminishing friction; such, for instance, as the adoption of wheels of a large diameter, for it was clear that fricton afforded but an insignificant part of the sources of resistance, while, by increasing the bulk of the carriage, they gave a greater frontage, and increased the resistance from other causes. Further, observed Dr. Lardner, it seemed probable that they should not with practical trains attain, in the present state of mechanical science, those extraordinary speeds which they were accustomed to hope for some time since. It was not at all likely that they should ever move at the rate of a hundred miles an hour, for the resistance due to the velocity would increase in so enormous a proportion, that it would become an opponent too formidable for any available power to overcome; still less was it likely that those speeds would ever be obtained with profit. Upon this subject Dr. Lardner remarked, "In some experience of railway traveling, I have never witnessed a speed exceeding 45 miles an hour; I did once accomplish that speed with four coaches, but only for a short distance. Mr. Woods has told me, that he has himself gone 48 miles an hour; but that was not for any considerable distance. Let it be remembered that great speed might be obtained in this way. You may get an engine with plenty of steam; you may screw the safety valve down so as to get a surcharge of steam; you may put no load on the engine, so as to diminish the resistance; and you may run it down a gradually declining gradient till you exhaust all the steam in her boiler upon a falling gradient. Then, if all these things be done, if the rails be clean, and if a correct account be kept, then there will be no denying that great speed has been attained. But when we speak of great speeds, this experiment, the whole length of the Grand Junction railway and back, at the average rate of 31 miles an hour through the whole distance, with 12 coaches, was a very respectable performance indeed, in the present state of locomotive power."

Lecture IV.

Dr. Lardner said there were two principles on which railways were generally constructed:—First, by departing as little as possible from the natural surface of the ground, and distributing the inclinations very generally and evenly over the whole length of the line, in which case such power was given to the engine, as to make it pull up the requisite loads with requisite speed. Others, on the contrary, proceeded on the principle of concentration, and instead of distributing the inclinations over the entire length, they threw them all into one place, as in the case of the Whiston and Sutton planes on the Liverpool and Manchester railway, and it followed, as a necessary consequence, that the engines which were adapted for working the greater part of such lines nearly on a level, could not easily draw the loads up the inclination, which must therefore be done by additional engines; but if it had been expedient to make the whole line with inclinations like those of the Whiston and Sutton planes, there would not have been the least difficulty in working it, and those planes would have been ascended with just as much speed as that part of the line was now traversed which was nearly level.

Dr. Lardner next proceeded to consider the source of the power of the engine, the manner in which it was produced, and the mode in which it was adapted to use. They should naturally suppose that an element in engine-making of such vital importance as the quantity of surface which

ought to be provided to receive the action of fire, in order to produce a given quantity of evaporation, ought to be known to engineers, but they would probably be surprised to find that even the best engineers were as ignorant of it as themselves. No two of them could agree, and they differed, not only in small quantities, but even as much as 100 per cent. Another thing of importance was the magnitude of the grate. Some held, that a square foot of grate per horse power was sufficient; some allowed more, and some less; but generally speaking, three quarters of a square foot was alllowed. In the application of fuel there was also considerable difference. It might be applied so as to produce considerable effect, or so as to produce comparatively little effect. In this consisted what was called the art of stoking; and in no place was this worse done, in no place did it need to be better done, than on board ships. The coals should be spread lightly upon the grate; and when in a state of incnadescence, the stoker should push it back, and lay on more coals. The first effect would be, that the coals first laid on would be coked. The gasses would be impelled forward by the draught; and as they passed the incandescent coal, they would be consumed, and no smoke would issue from the chimney, the smoke being the unconsumed part of the fuel. As soon as the coke at the back was consumed, the stoker should push back that in the front, and introduce a further quantity of fuel. This would make a common furnace, in fact a smoke consuming furnace, and there would be a uniform evaporation of steam. But was this the practice observed? By no means. Neither in marine boilers nor in land boilers had the stoker any idea of taking any such pains; he adopted, not the most efficient way, but the way most comfortable to himself. He proceeded in this way: he let the fire in the grate be nearly out, he then put in an enormous quantity of coal; the consequence was, the very instant this was laid on, there issued an enormous quantity of smoke, which might be frequently seen issuing from the chimney of a steamboat. That went on for some time, till at length the chimney got a little rest. This was nothing more than the effect of putting on fresh fuel; and the smoke continued till it was burned red, and it suited the stoker's pleasure and convenience to open the grate again. They paid their stokers sufficient wages, and made them do their work; and on the *Medea*, for instance, there was no smoke from the chimney at all. There was nothing new in this. Mr. Watt proposed it; and in his factory at Soho, smoke was never seen issuing from the chimney. The only effectual remedy which could be devised would be to feed the furnace by self-acting grates. One had been invented in which the grate was made circular, and it revolved. The feed of coal was placed in a hopper, and the coal passed through it like a funnel. The coal was put in that part of the grate furthest from the flue. This machine was kept in motion by the engine itself, so that to a furnace of this kind there was little necessity for the attendance of men at all.

REPORT, SURVEY AND ESTIMATES OF THE ATTICA AND BUFFALO RAILROAD, MADE TO THE COMMISSIONERS, JULY 1, 1840. By George Rich, *Engineer.*

GENTLEMEN:—I have the honor to submit the following statement of the examination made by me, (assisted by William G. Bullions, of Schenectada,) with a view to the construction of a railroad from the village of Attica, Genessee county, to the city of Buffalo.

The survey commenced on the table land in the centre of the road leading from Attica to Alexander, a little north of the furnace, and near the probable termination of lhe Tonawanda railroad, at a point that may be varied to suit the location of that road, and ended on Batavia street, near the court house, in the city of Buffalo.

Length of line from commencement to termination, 30 miles 180 feet.

Length of line from commencement to corporation line, 29 miles 1780 feet.

Height of summit above grade at commencement of survey, 86 feet.

Height of summit above grade at corporation line in Buffalo, 424 feet.

Height of grade in Attica, above Buffalo, 338 feet.

By Elisha Johnson's survey to Batavia.

Distance from Attica Mills to Batavia, 10 miles.

Height of Attica above Batavia, 73 feet.

As the present survey was commenced 1200 feet northwest of the Attica mills, I will, for an estimate of distance between Batavia and Buffalo, call it $10\frac{1}{4}$ miles, from the commencement of the present survey to Batavia.

Distance from Batavia to Attica,	$10\frac{1}{4}$	miles.
" from Attica to Buffalo,	30	"
Whole distance from Batavia to Buffalo,	$40\frac{1}{4}$	"

From Attica, the route takes a northwesterly direction, following the south side of the ravine to the summit, which is a little over two miles. As the greatest difficulty was to be apprehended on the whole route, between Attica and the summit, I will, before proceeding any farther westward, give the result of the different routes examined, between Attica and the summit, one on the south, and one on the north side of the ravine.

The summit may be reached by the south line, on a grade of $43\frac{10}{100}$ feet per mile, crossing the Tonawanda valley directly in the village of Attica; and at some considerable expense over the north route. For difference, see estimate.

The north line would not cross the Tonawanda valley, and would leave the village of Attica $\frac{5}{8}$ of a mile to the south of the line, and make a saving of half a mile in distance between Batavia and Buffalo. The grade is less upon this route, being $39\frac{74}{100}$ feet per mile, and not so expensive as the south route, as it avoids the heavy embankment across the Tonawanda valley.

The whole distance by this route, from Batavia to Buffalo, would be $39\frac{3}{4}$ miles, and the highest grade $39\frac{74}{100}$ feet per mile.

Radius of smallest curve on the north route, 2150 feet.

" " " on the south route, 1420 feet.

No other curve, upon either route, of a less radius than 4000 feet.

By a reference to the profile, it will be seen that the highest grades upon the route, are upon this two miles east of the summit—the highest a fraction under 44 feet per mile, and the lowest a fraction under 40 feet per mile. If the grades upon the Tonawanda road were any less than these, it would be necessaay to make a deep and expensive cut at the summit, to reduce the grade or abandon the enterprise entirely, as lower grades may be had by the direct route to Buffalo. If I am correctly informed, there are grades between Rochester and Batavia, on the Tonawanda road, ascending in the same direction, as high as 44 feet per mile. The same engines would probably run the whole distance from Rochester to Buffalo, and the engine that brought a train to Batavia, could take the same to the summit west of Attica.

I would not, therefore, recommend an expenditure of money beyond what would be necessary to bring the maximum grade to 40 feet per mile.

From the summit to Alden, a distance of 9 miles, is a descending grade, with the exception of one undulation passing from one valley into another, near Pratt's mill. Immediately at the summit, the line passes through a meadow, situated on a long roll or swell of land, upon which it is difficult to detect the highest ground, without an actual level, for many hundred feet;

making it very expensive to attempt a reduction of grade by a deep cut at the summit. The difficulty of disposing of the material would be another objection to a deep cut, as there is no embankment on either side of the summit to exhaust the material, within a reasonable distance.

From the summit, the line continues near a northwest course for about two miles, through a broad valley of cultivated fields, frequently crossing a small stream of from 3 to 4 feet between its banks, which winds along nearly in the direction of the line, and passes off in a northerly direction. The line curves a little to the west, near Thomas Cooley's, and rises over a swell or ridge of land to Peters' swail, crossing in its course a small stream called Murder creek, where a bridge of 30 feet span will be required.

From Peters' swail, the line runs nearly a west course 2½ miles, through dry, open, cultivated fields, to one of the branches of 11 mile creek, where another bridge of 30 feet span, will be required; thence the line curves slightly to the north, and follows the same broad valley, to the main street in Alden, crossing in its course, two more small branches of 11 mile creek, where I would recommend a bridge to each, of 30 feet span. The line also passes through a number of small patches of timber, of from 2 to 600 feet in extent, that will require grubbing.

The line will enter the main street in the village of Alden, near Bishop's store; thence on the north side of said street to Gage's hotel, in said village. At this point we are 11 miles from Attica, and the line has generally passed over a cultivated and even surface of land, requiring but few excavations, and but very little grubbing.

From Alden to Buffalo, a number of routes present themselves, all feasible, and varying but little in actual cost of construction. The preference to be given one route over another, is the direction and roadway, it being desirable to make the line as short and the right of way as cheap as possible. The one surveyed, was the one from which the least opposition was to be expected from the farming interest, and least claims for damages.

From Buffalo to Alden, the line is 19 miles long, and divided into three straight lines, and two curves; 7½ miles of it upon roads but little used, and scarcely worked—2 miles parallel with the highway, and no buildings to be disturbed—5 miles along the line of lots dividing farms, and the balance of the distance, 4½ miles, through farms where the right of way will have to be purchased.

The line from Alden, follows the old State road as far as it is open; thence entering the woods upon the line of lots, 2½ miles of which is covered with a heavy growth of hemlock and ash; surface soft and swampy, but not deep; the land is easily drained, as it has a descent in the direction of the survey of 30 feet per mile. Thence the line continues through open fields and small pieces of timber, to within one mile of Lancaster, where we are obliged to leave the line of lots and curve to the north, around the village, keeping upon the table land above the Cayuga flats. Thence we run a west course, crossing the Buffalo road in front of Hitchcock's and keeping on the north side of said road to its junction with the Ellicott road; thence on the north side of said road, to Batavia street, in the city of Buffalo.

The soil through this section of country is clay, with the exception of a narrow strip of sand and gravel, of two miles in width, crossing the line after leaving Alden. From appearances, I do not think we shall find a yard of rock excavation on the route; and the entire absence of good building stone, compels me to estimate for wooden culverts and small bridges, which I would not do if good building material was at hand; as there is not a stream upon the whole route but what a 15 foot culvert would be suf-

ficient to carry the water at any time. The most expensive part of this route is the first two miles from Alden, requiring deep excavations and heavy embankments,—the soil in this instance happens to be sand and gravel. The most of the way from Attica to Buffalo, may be an embank ment road, which is preferable, when the soil is principally clay. Embankments are generally harder, and the road is easier drained than excavations, and easier kept open in winter.

All the necessary excavations upon this road I would make 10 feet wider than usual, so as to allow of deep, broad ditches. Experience has proved that effectual draining is of the utmost importance, particularly in excavations, where they are liable to be filled, from slides, and a variety of causes checking the water and softening the road, and continually subjecting the company to heavy expenditures to keep the road in repair. A great proportion of the expense of keeping a road open in the winter, is caused by the difficulty of disposing of the snow in the excavations, which would be in a measure relieved by wide excavations, and entirely so upon an embankment road.

I would not recommend in the first stages of the work, the usual heavy outlays for car houses, shops, or permanent buildings, except water stations, wood houses, etc. It frequently happens that the first location is not the best one. Buildings can be erected after the road is completed, adapted to the business of the road. Neither would I recommend a more expensive outfit than just sufficient to run the road, as it is quite probable an arrangement can be made with the Tonawanda company, to run the road.—Their engines and cars could do the business of both roads, at a small addition to their present expenditures.

The timber upon the line is principally beech, maple, elm, ash and hemlock; some oak, but very little immediately upon the line of the survey. Lands a little south on the reservation, are thickly covered with oak, from which a good supply of ties and rails may be procured. Hemlock sills may be obtainted along the line. The kind of road I would propose here would be of the same pattern as the Utica and Schenectada road, with rather heavier sills, and shorter bearings.

Sizes of Timber.

Sills—5 by 12, 30 feet long—hemlock.
Ties—6 by 6, 8 feet long—white oak.
Rails—6 by 6, 24 feet long—white oak.
Iron—$2\frac{1}{2}$ by $\frac{7}{8}$ inches.

The ties should be procured from young second growth oak, from 8 to 10 inches diameter, and hewn on two sides—if not, take them from trees large enough to quarter, and make them triangular. The sills should be 5 by 12, and 24, 27 and 30 feet long. The rails 6 inches square, 24, 27 and 30 feet long. The iron estimated is heavier than usual. Experience has proved that the usual thickness, $\frac{5}{8}$ of an inch, is too light to keep the superstructure firm and solid, which is more needed upon a clay soil, than a gravel. The following estimate of a single mile, together with the estimate of the whole line, is respectfully submitted.

Estimate a single mile of superstructure.

52,800 ft. hemlock sills, 5 by 8, 30 ft. long, at $8,	$422 40
2,000 ties per mile, 6 by 6, 8 feet long, at 20 cts.	400 00
31,680 ft. white oak rails, 6 by 6, at $15,	475 20
33 tons of iron, per mile, $\frac{7}{8}$ by $2\frac{1}{2}$ in., at $60,	1,980 00
Spikes, - - - - -	133 00
Wedges, - - - - - -	20 00
Workmanship, - - - -	640 00
	$4,070 60

Estimate for a single track railway from Attica to Buffalo.

1st division, from Attica to Alden, 11 *miles.*

51,657 cubic yds. excavation, at 11 c.		$5,682 27	
97,926 do embankment, 14 c.		13,709 64	
8,000 do in ditches, 14 c.		1,120 00	
2 miles of grubbing, at $800,		1,600 00	
			22,111 91

2d division, from Alden to Buffalo, 19 *miles.*

261,000 cubic yds. embankment, 14c.		$36,540 00	
72,620 do excavation, 11c.		7,988 20	
15,000 do in ditches, 14c.		2,100 00	
2½ miles of grubbing, at $1,000,		2,500 00	
			$49,128 20

Bridges, road crossings, etc.

32 small bridges, from 6 to 8 feet, in place of culverts, at $70,			$2,240 00
8 do 10 feet, do at $90,			720, 00
6 do 30 feet span, 500,			3,000 00
1 road bridge,			1,600 00
26 road crossings,		15,	390 00
76 farm crossings,		10,	760 00
36 cattle culverts,		40,	1,440 00
30 miles superstructure,	4,070 60		122,118 00
1 mile of superstructure in 6 turns-out,			4,070 60
12 switches,		110,	1,320 00
Agents, commissioners and preliminary surveys,		$8,000	
Pay of engineers, for 2 years,		15,000	23,000 00

Permanent Buildings.

4 water stations,	at $2,600	
4 wood houses,	2,400	
1 engine house,	3,000	
3 large and 8 small turn tables,	3,100	11,100 00

Temporary Buildings.

2 car houses,	3,000	
1 engine house,	1,200	
1 car house,	1,000	
1 freight house,	900	
1 carpenter's shop,	600	6,700 00
		$249,678 71
Add ten per cent. for contingencies,		24,969 87
		$274,668 58

Outfit,			
3 engines,	$7,000,	$21,000	
8 long passage cars,	1,700,	13,600	
2 post office cars,	620,	1,240	
4 baggage cars,	550,	2,200	
30 freight cars,	290,	8,700	46,740 00
			$321,408 58

Average cost of construction, $10,713 62 per mile, including ontfit.

Estimated expense of southern line, in village of Attica.

46,200 cubic yards of embankment in Tonawanda valley at 20c. - - - - - - - - -	$9,240 00
Bridge across the Tonawanda creek, - -	3,000 00
½ mile saved in distance, at average of whole,	5,356 81
Cost over north route,	$17,596 81
Whole capital, - - - - - - - -	350,000 00
Cost of construction, - - - - - - - -	321,408 58
Amount applicable to settlement of lands and damages, - - - - - - - - - -	$28,591 42

All of which is respectfully submitted,

GEORGE RICH, *Engineer.*

Attica, July 1, 1840.

More Locomotives.—The engine "America," for the Worcester railroad, Massachusetts, was shipped yesterday morning; and another for the Memphis and La Grange railroad, Tenessee, is to be shipped in a few days. Both are from Mr. Norris's factory. They have both eight wheels, and are of great power.

TRIUMPH OF STEAM—A RAILROAD TRAIN.—The Boston Daily Advertiser of the 21st instant states that "the eight wheeled locomotive engine America, built by Mr. Norris, of Philadelphia, left Boston on Wednesday for Worcester, with a load of one hundred and fifty tons of merchandize for the purpose of an *experiment* on the Western Railroad, from Worcester to Springfield. The train arrived at Worcester on Wednesday evening. We have not heard of the result on the Western Road. The load consisted of 150 tons nett of merchandize, exclusive of the cars and tender, which must have weighed nearly one hundred tons more."—

This "experiment" is interesting to us New Yorkers, in as much as it presents the fact, that a single locomotive has drawn a gross load of about 250 tons or 150 tons nett from Boston to Worcester, and has no doubt carried it to Springfield over grades of 60 feet. This feat should not leave a doubt, that on the completion of the Western road to Albany, 1000 barrels of flour may be carried in one train. Trains started every half hour, with suitable turn-outs, present the capacity of the "Great Western Railroad," equal to 48,000 barrels of flour per day. An amount greater than can be passed on the Erie Canal during one days lockage.

This experiment induces further reflection "that which has been done, can be performed again." It is, as to the cost of transportation on railways. We find it recorded that one of Mr. Norris' engines drew over the Philadelphia and Reading Railroad, 54 miles, at the rate of ten miles per hour, 101 cars, containing 323 tons nett load, exclusive of cars and tender, at the trifling total expense of $57. This sum included fuel, oil, engineers, four men at the breakes, with $20.20 per diem, allowed for the use of the 101 cars at 20 cents each. It is true this road is nearly level, or descending. It, however, establishes the great power of the locomotive engine, for transportation on a well constructed railway, and there should not be a doubt in our minds, that the Bostonians, at the close of the next season of navigation of our Erie Canal, (1841,) will be able to carry a barrel of flour, the 201 miles, from Albany to Boston, for 25 cents per barrel, with a remunerating profit to the road. This they can do, if one-fourth of the capacity of the road is taxed, and they have the usual travel which so great a thoroughfare promises.

DANGERS OF RAILROAD TRAVELLING.

It is ascertained by experiment, that the danger of loss of life on an average railroad trip, is as about 1 to 4,000,000. The following data on which this conclusion is founded, are copied from a late British publication:

Name of railway.	*No. of miles.*	*No. of passengers.*	*No. of accidents.*
London and Birmingham,	19,119,465	541,360	3 cases of contusion, no deaths, (1)
Grand Junction,	97½*	214,064	2 cases slight do (2)
Bolton & Leigh, and Kenyon and Leigh,	3,923,012	508,763	2 deaths, three slight contusions, (3)
Newcastle and Carlisle,	1*	8,540,759	5 deaths, 4 fractures, (4)
Edinburgh and Dalkeith,	7*	1,557,642	One arm broken,
Stockton & Darlington,	2,213,681	357,205	None,
Great Western,	4,109,538	230,408	None,
Liverpool and Manchester,	30*	3,524,820	Eight deaths, no fractures, (5)
Dublin and Kingston,	1*	26,410,152	5 deaths and contusions to passengers,
London and Greenwich,	484,000	2,880,417	One passenger slightly bruised.

* Length of road.

(1) None of these accidents occurred to actual passengers.
(2) None of these accidents occurred to actual passengers.
(3) None of the persons killed were passengers.
(4) One of the persons killed was a passenger.
(5) The whole of these were passengers; one of them a serjeant in charge of a deserter, who jumped off the carriage whilst in motion; the serjeant jumped after him to re-take him, but was so much injured that he died; three others got out and walked on the road, and were killed; the rest suffered by collisions of two trains, at different times. These include all the casualties from the very commencement of the working of the line.

REPORT OF THE ENGINEER IN CHIEF OF THE GEORGIA RAILROAD AND BANKING CO. TO THE CONVENTION OF STOCKHOLDERS.

ENGINEER DEPARTMENT, GEO. RAILROAD, AND BANKING CO.
Greenesboro', *April*, 29*th*, 1840.

To William Dearing, Esq., President Georgia Railroad, and Banking Company:

Sir:—At the period of my last annual Report, a party of my assistants were engaged in making experimental surveys of the country between Yellow river, and the southern terminus of the Western, and Atlantic railroad; having previously completed a preliminary location of the road below that river. These surveys were continued untill the illness of my principal Assistant of location rendered it expedient to disband the party. After carefully collating the information collected by them. I am fully satisfied that the estimate I ventured to make in my report of the cost of this extension ($1,200,000) was sufficiently liberal. If the recent fall in the price of iron is permanent, it will be found to be too high.

In conformity with a resolution of the Board, in February last; the lo-

cation has been again resumed, and a revision of that part of the line crossing the Alcovy river, already made. Although we have been unable to effect any great saving in the amount of work to be executed on this difficult division of our route, yet we have succeeded in obtaining a line free from soil of uncertain character.

The preliminary location of the road has now advanced to a point nearly opposite the Stone Mountain, and will be continued thence along the course of the ridge parting the waters of South river from those of Yellow and Chattahochee rivers, to the Western, and Atlantic railroad. Other lines will also be traced with a view of obtaining a route which will afford the greatest facilities for a connexion ultimately with West Point.

As soon as the final location has been made of the whole line, I will prepare a detailed estimate of the cost of the work, and report to the Board the result. In anticipation of meeting with much rock excavation, I have taken measures to have each cut bored, that an estimate may be presented that can be fully relied on.

The graduation and bridging of the Madison Branch, with an immaterial exception, is now finished. Upon the Athens Branch, there remains about five miles to be completed—two of which have not yet been commenced—the whole will be prepared during the ensuing summer, or fall. The cost of grading unfinished on both branches, is estimated at $33,-027 00.

A contract for laying the superstructure of the Madison Branch, was entered into in July, 1839, with Weaver & Co.; the whole to have been completed in March last, but owing to the low stage of the river, when our iron arrived at Savannah, and the continued drought during the entire summer and fall, we were unable to deliver them the necessary materials to commence operations with until December. As this was the most unpropitous season possible to procure labor, but little was done before the middle of January; since that time the work has progressed very satisfactorily. In one or two weeks we shall cross the Oconee river; and I entertain no fears of being able to reach our depot near Madison, in ample time for the next crop.

Our order for iron for the Madison Branch, was 1800 tons, of this amount I have been advised of the receipt of 1,757½ tons. In addition to this, I understand that about 24 tons were shipped by the Governor Troup, making a total of 1,781½ tons, leaving a deficiency of 18½ tons. In consequence of this deficiency, together with the increased size of the bar received over the specifications sent (a liberty which manufacturers frequently lake when an agent of the company is not present) our iron will not reach the point designated for the terminus of the road in Madison. We shall, therefore, be under the necessity of transacting our business this year about 1½ miles below the town, on property belonging to the company. While this arrangement will deprive us for a time of some of the conveniences of a nearer location to the village; the disadvantages arising from it, will be fully counterbalanced by the ample space we shall have for transacting our business, which could not be obtained in the town without a resort to considerable expense.

The amount necessary to complete the superstructure of the Madison branch, including the sum required for iron, cross ties, and mud sills, is estimated at $37,916 00.

Twelve miles of the superstructure of the Athens branch will be finished this season, if the iron arrives in time. The remainder can be completed during the ensuing year. The iron on hand will extend about 7 miles. The additional order sent forward will enable us to reach a short

distance above the Washington, and Athens road, leaving a distance of 12 miles to be provided for. The amount necessary to complete the superstructure of this branch is estimated at $196,596 00. If we add to this the estimate for completing the superstructure of the Madison branch, and the cost of grading yet unpaid, we shall have the whole amount required for road construction $266,539 00. This includes all work done upon which an estimate has not been returned. In addition to the above, we shall require for the construction of cars, depot, and passenger office at Augusta, about $26,000 00.

Our present motive power, it is believed, will be sufficient to do the business of the road for the ensuing year.

The length of road in use (including the $3\frac{1}{2}$ miles of branch road to Warrenton) for the past year has been 88 miles. The cost of repairs, and police for this distance, you will perceive by reference to the accompanying statement marked No. 9, is $17,170 75-100 for the eleven months, ending on the 31st ult., or at the rate of $195 per mile.

If we take into consideration the high price paid for labor, and provisions, this result must be considered very gratifying. Upon the Richmond, and Fredericksburg railroad, a work which went into operation about a year before ours, the cost of repairs of road according to the last annual report of that company was $927 per mile for eleven months—on the Roanoke, and Petersburg railroad, the annual cost of repairs are stated by H. D. Bird, Esq., engineer and president of the company, to vary from $550 to $750 per mile per annum. These roads are constructed with the ordinary flat bar of $\frac{1}{2}$ inch in thickness. Our iron for 79 miles, you are aware is of the same description, but heavier, being $2\frac{4}{10} \times \frac{8}{10}$ inches. On the remaining distance the inverted T rail is used, the maintenance of which has not exceeded $75 per mile.

We have now given the expense of maintaining our road, and those of like construction but of lighter iron, where labor is 70 per cent. cheaper than it is with us. The roads referred to have been selected, because we have not had access to the statements of any other companies on which the plate rail is used. If we take the three principal roads of New England, which are constructed with heavy iron edge rails in the best manner, the comparison will still exhibit our expenditures in a favorable light. On the Boston, and Lowell railroad, the annual expense of maintaining the road last year, was $731 per mile; Boston, and Providence, $209; and Boston, and Worcester, $405. It is also to be recollected, that our passenger train traverses the road in both directions after night, which adds considerably to the expense of its maintenance. This is not the case on either of the works referred to, except the Richmond, and Fredericksburg railroad.

If either of the items of our current expenses is compared with the published reports of other companies, we shall find the same favorable result. We have entered into these comparisons for the purpose of showing to the stockholders, that as large as our expenses may seem to them, they are not greater than those of other railroad companies, who are much better situated for procuring labor, and materials on favorable terms. For instance, our iron used in the shops, costs us in consequence of the difference of freight, about 25 per cent. more than it would at the north, and our enginemen, and machinists, and blacksmiths are paid from 50 to 100 per cent. higher wages.

The motive power department has been re-organised since my last report with evident advantage to the company. The work done in the shops is greater than it was last year, and with a less amount of labor.

The engines have been kept in excellent order, and have never failed to perform the duties required of them on the road. Two new locomotives, and three tenders have been added to our machinery during the year, making the whole number of engines, twelve, all of which are in good order, or can be placed so in a few days, except the Georgia; the latter engine is undergoing a thorough repair; when completed she will be fully as valuable a machine as when placed on the road. I refer you to the accompanying document, No. 9, for a statement of the expenses of motive power, and to No. 10, for a detailed statement of the repairs of each engine, and the distance run in miles,

During the prevalence of the epidemic in Augusta last fall, our machine shop was maintained at a considerably increased expense relatively. The cost of the work done in consequence, was much enhanced, which being charged to the several accounts at the usual rates has left a ballance against the shop. This amount is added to the current expenses under the head of loss from contingencies. For a statement of the business of the machine shop and car factory, I refer you to documents No. 11, and No. 12.

The business of the road is exhibited in detail in documents, Nos. 1, 2, 3, 4, and 5. In Nos. 6, 7, and 8, the same is shown in a more condensed form. The following statement gives a general view of the receipts and disbursements on account of the business of the road for the eleven months ending on the 31st of March, to which period the accounts have been made up to correspond more nearly in time with those of the bank.

Business of the Georgia Railroad—eleven months.

Dr.	To expenses of conducting transportation,	$21,969 33
"	" " Motive power,	26,141 22
"	" " Maintenance of way,	17,170 79
"	" " " " Cars	4,965 00
	Total,	$70,246 34
Cr.	By amount received for Freight,	$101,420 25
"	" " " Passengers,	63,505 21
"	" " " Mail,	17,940 81
"	" " " Miscellaneous,	1,737 27
	Total,	$184,603 54

In comparing the several statements in relation to the business of the road with those furnished last year, you will perceive that there has been a falling off in the number of passengers in the corresponding months amounting to 3,806, while our expenses in this branch of our transportation have been considerably increased by a contract with the post office department for carrying the great northern and southern mail in both directions after night, and the maintenance of a tri-weekly day line for the accommodation of those who are unwilling to venture in the mail train. We were induced to enter into this arrangement for the purpose of expediting the mail, and travel between the North, and South, believing it to be our duty, occupying as we do, a portion of the great thoroughfare connecting these extremes of the Union, to yield our preferences as to time to those of the public good and convenience.

The compensation we receive from the department, however, for this extraordinary service, repays us but very inadequately, for the additional risk, and expense encountered. The Post Master General, by a singu-

lar construction of the law of congress, limiting the terms he should grant railroad companies, has fixed the maximum rate of compensation for mail service at $237 50-100 per mile, and has offered this sum to all companies that have surrendered to him the control of their hours of arrival, and departure, without admitting any difference of compensation whether the service was to be performed by night, or by day. The injustice of this decision is so apparent to those at all acquainted with railroad transportation, that it is a matter of surprise that it has been maintained. If the low amount which will be paid under this construction of the law to the several railroads between this place, and New York, have been distributed among the companies upon equitable principles, having reference to the hours the service is performed, I have no doubt general satisfaction would have been given to all parties.

In our contract I succeeded in making arrangements for the transportation of the mail over the whole length of our road, and to be extended as the work advances—it having previously left the line at Warrenton. If this object had not been yielded to us, we could not, with a due regard to the interests of the company, have acceded to the onerous conditions imposed.

We have thus far been peculiarly fortunate with the night line, having met with no accident of importance during the 10 months we have been running. Our mail failures in both directions have only been seven, three of which were occasioned by heavy sleet on the rails, preventing the adhesion of the driving wheels of the locomotive, and of course the progress of the train.

The decrease in the number of passengers already alluded to may be partly accounted for by the prevalence of the epidemic in Augusta, and the removal of the Florida line of stages from the head of the road. But it is mainly to be attributed to the derangement of the monetary affairs of the country, and consequent depression in business of all kinds, which also satisfactorily accounts for the diminution in the amount of up freight during the months of February and March last.

The Florida line of stages, after an ineffectual attempt to divert the current of travel from our road to the route via Brunswick and Tallahassee to Mobile, has again resumed its regular trips from this place to Bainbridge on Flint river, where the passengers now take steamboat.

In the aggregate our business for the eleven months shows an increase over the whole of last year of $49,873 12-100 while our expenditures have only been increased $6,884 20-100. A much larger amount of business in up freight and passengers could have been done without adding to our expenses.

Our nett profits on the road, and machinery in use which is estimated at $1,300,000, is nearly 10 per cent. per annum.

For the favorable exhibit we are enabled to make of the year's operations, the company are much indebted to the Superintendant of transportation and Assistant Gen. Agent, Richard Peters, jr. The able and efficient manner he has fulfilled the duties of the department under his immediate control, and seconded me in all the operations connected with the finished road, render this acknowledgment of his services an act both of duty and pleasure.

As the rates established by our charter for the conveyance of passengers, yields the company an inadequate compensation for the expenditures, on this branch of their business, I would respectfully suggest to the board the propriety of an application to the next Legislature, for, either an increase of the rates, or a removal of the res-

triction altogether, as has been done in the charters of the other railroad companies of this State. I cannot see that any reasonable objection can be urged to this request, especially as it would enable the company to reduce their charge on freight, which is paid almost exclusively by citizens of Georgia, while scarcely one half of the passengers are residents of the State. But apart from these considerations, it is unquestionably the true policy of the company and their customers to make each branch of the business bear its due proportion of the burdens. Our charges for passengers are now 30 per cent. below those of the railroad companies in Virginia, and at the North generally, where nearly all the elements of the cost of transportation ought to be less than with us, and 50 per cent. lower than the rates of the S. C. C. and R. R. Co. The rates fixed by our charter for freight are sufficiently high in the aggregate. But even in this branch of our business the company might, if not so narrowly restricted, establish a tariff of prices more in conformity with the laws of trade, and much more satisfactory and beneficial to the community who make use of the facilities afforded by the improvement.

In conclusion, I will observe that the result of our last year's business has greatly strengthened my faith in the profitableness of railroads. The nett revenue on our whole expenditure, about $700,000 of which is dead capital, is at the rate of 6 per cent. per annum, notwithstanding our low charges for passage, and the general stagnation of the business of the country. I can now state with confidence that wherever the transportation is of a mixed character, such as agricultural products, general merchandize, and passengers, and sufficiently large to justify the construction of a *good road*, railroads will be found to be not only the most expeditious, but the cheapest artificial medium of conveyance at present known.

A certain quantity of business at our rates is required to defray the cost transportation, and all above this amount, deducting merely a small portion for additional current expenses, will be the profits on the capital invested, and as this capital remains nearly the same for a large or small business, it is evident that the revenue of the company is increased in proportion as the business is enlarged above this point. It is mainly in view of this fact that I have so earnestly urged upon the board the importance of continuing our road to the Western, and Atlantic railroad, thereby directly connecting it on the one hand with the navigable waters of the West, and on the other, through the Hiwassee railroad with the heart of the rich valley watered by the Tennessee river.

The increase in our business from these sources, especially during the winter, and part of the spring, when the Northern channels are closed by ice, will exceed our most sanguine anticipations.

Goods have already been forwarded from this place to points in Tennessee, beyond the Cumberland Mountain under all the disadvantages of wagon transportation of upwards of 250 miles.

This shows that no effort on our part, other than the completion of our road, will be required to divert the trade of a large portion of the West from its old channels. The greater facilities afforded at the southern terminus of our road for distributing the heavy produce of this region to the various marts on the Atlantic sea board, must secure to us the chief part of its transportation.

Respectfully submitted,

J. EDGAR THOMPSON,
Chief Engineer, and General Agent.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 6, Vol. V. New Series.	SEPTEMBER 15, 1840.	Whole No. 366. Vol. XI.

ADVANTAGES TO FARMERS AND GARDENERS FROM RAILROADS LEADING TO LARGE CITIES.

The importance of railroads to a large and valuable portion of our community, that are engaged in the culture of the soil, has often been insisted upon. The benefits to be derived have been set forth as arguments for the construction of all new works—and yet, upon some lines of railroad, this important branch of business has neither been encouraged, nor even apparently cared for. That this is a great mistake must be admitted by all sensible men, and the fact that this mode of communication offers great advantages over every other, to farmers, is sufficient ground for making express preparations to entertain this kind of traffic. As a confirmation of this, we refer to a circumstance mentioned in the report of the Camden and Amboy railroad. A line of one or two cars was daily dispatched from Camden not with any other idea than the accommodation of the neighboring farmers. This line, called the "Pea-line" has now become an important part of the business of the road, and as an instance it is stated that on one occasion, no less than *thirty-one tons of green corn* was sent from Camden.

The first and most obvious advantage, is the rapidity and facility of communication. Produce can be carried to a market from places remote, in a shorter time than from much nearer situations by ordinary method. By the gain in time and decrease in expense, the farmer is not limited to the immediate vicinity of the city, where land always bears a proportionably high value, but can at a distance inaccessible to a city market by other means, realize the full benefit of a close proximity.

Large cities create a market, for many articles not known elsewhere, as each man throughout the country supplies himself, but never raises a surplus, as he has no means of disposing of it. Under this head we refer more particularly to garden produce.

In a city are to be found consumers enough but no producers; the con-

sequence is, the high price of fresh vegetables and fruits. Were the supply for this demand to be derived entirely from the environs of the city, neither party would gain much—consumers would have to pay high prices and yet producers would reap but little profit. A railroad, however, brings the whole region through which it passes into the situation of a market garden.

The easy safety, and convenience of railroad travel enables the farmer or gardener to deliver certain articles in better condition after 30 or 40 miles transportation, than after 3 or 4 miles jolting over a rough road.

The saving of time is no less an advantage. Some kinds of fruit, for example, cannot be kept over a certain time; but we now have the means of flying over a hundred miles in as little time as such things are generally carried 25 or 30 miles. The city, in return for the produce of the soil, returns to the country street manure, poudrette, or the refuse of manufactories. These articles are as much limited in their circulation by expense of transportation as any other, and are also carried to a greater distance as that expense decreases.

The great variety of the articles of city consumption requires an almost equally great variety of soil and exposure. These, of course, cannot all be obtained within a few miles circuit, but railroads afford the greatest possible choice in this respect, giving access to a far greater extent of country.

It is to be remarked that by the facilities for quick and easy transit now afforded between our large cities, many articles find their way from one market to the other, and consequently a demand is kept up, when, but for this outlet a glut would soon take place. In the early part of the spring southern fruits come to our markets, as the season advances we supply them when their own fruits are over.

The farmer can enjoy all the benefits of a city residence without any of its disadvantages, (and they are many.) His family live more agreeably, comfortably and rationally, than any where else, and he is thus enabled to maintain what, if intelligent and wise, he well deserves—the highest rank in our population.

It is true that many, sometimes most of these benefits, are lost by improper management, or by the incomplete state of the road. It is no more fair to judge from these, than from a house without a roof or doors to argue against such an edifice being comfortable as a habitation.

We may at some other time return to this part of the subject and show wherein the folly and danger of such mismanagement lies, and illustrate our position by actual cases.

We have received the following reply to a request from this office, that Mr. Lee would furnish us with the result of the experiment on his road. The arguments which he adduces in favor of general contracts, are sound and worthy of consideration. We have long been of opinion that the multiplicity of section contracts, was a great evil upon all public works, and

particularly upon short works, where such sub-division of labor is totally unnecessary.

To the Editors of the American Railroad Journal and Mechanics' Magazine.

GENTLEMEN :—The want of time has deprived me of the pleasure of replying sooner to your favor of the 12th ult., and even now, I fear my engagements will not allow me to be as particular as I should otherwise desire.

In your note, you say "Will you state to us, for publication in the Railroad Journal, the advantages of that mode of contracting, (alluding to *general contract*,) for works of Internal Improvement."

Having tested the principle fully upon the New Bedford and Taunton railroad, just completed under my direction, I shall be able to give facts ascertained from my experience.

I have found these three advantages resulting from that mode of contracting,—viz.

1st The work can be constructed *cheaper.*

2d It can be constructed more *expeditiously.*

3d It can be constructed with less trouble to the President, Engineer, and officers of the corporation.

Mr. Locke, the Engineer of the Grand Junction railroad in England, says in his evidence before a committee of Parliament, in the course of examination, "I think work may be executed much *cheaper, in large contracts.* When a contractor has a number of things to do, he makes one part *fit* in with another."

There is great truth in the remark, which may be illustrated in the following manner.

Under the usual mode of contracting, (in this country,) viz. section contracts, the work is divided into short sections, from a half mile to a mile and a half in length, according to the nature of the ground, to equalize the excavation and embankment, as near as possible on the section, and upon the section the *graduation* is usually given to one contractor, the *masonry* to another, and the *bridging* to a third.

Now let us see if the same section could not be constructed *eheaper* under general contract. What has the contractor for graduation to do? He has to form the embankments on his section from the excavation on the same. Suppose rock is found in the course of the excavations? The contractor for graduation is compelled by his contract to quarry it, and to use it in the formation of his embankment (if not inexpedient) or to remove it within the average haul of his section.

The contractor for masonry, in like manner has to find stone, haul them and construct his viaduct, culvert or bridge abutment, etc., as the case may be. Now it is evident that if the graduation and masonry were both done by the same contractor, that the rock taken from the excavation would go into the viaduct, bridge abutment, etc., and thereby save *quarrying, loading* and *unloading*, and in many cases, also save the "*quarry lief* ."

And to these may be added the great liability (where you have two contractors, and the progress of the work of one dependant upon the completion of that of the other,) for damages arising from the waiting for, or detention of one or the other. The case in point is a common one, easily understood; and I have used it to illustrate the operation of many others, which if my time permitted I might give.

In the construction of every work where you cannot be certain of its *nature*, much of it will be found to prove *worse* than was anticipated; while on the other hand, much will be found to prove *better*. Now what is the effect of this variation upon a work done by section contracts? By one experienced in the construction of works, the question is easily answered. The fortunate contractor who gets the section which proves better than was anticipated, completes his work, pockets his gain, and is off to seek employment upon some other work. But what becomes of the less fortunate, whose section proves to be worse? He appeals to the Engineer and through him to the directors to increase his pay for the work, or he has no alternative but to abandon it, and lose the portion held by the company upon the work already done, as a guarantee for the completion of his contract. Then what is the result? The company must either increase his pay to a fair price for the work, or give it to some other person who would certainly not do it for less than the contractor who began it and is fitted for it. And the result of experience is, that when a work has been abandoned by the original contractor, not only much time is lost, but great expense is incurred in resuming it.

Under a general contract the effect would be different, for the same contractor would have that which proved *better* than was expected, as well as that which proved *worse*, and there could therefore be no just ground for his claiming an advance of price upon that which proved worse when a corresponding portion proved more favorable than was anticipated.

Had the New Bedford and Taunton railroad been constructed by section contracts, several of the sections must have been abandoned or the price for them must have been advanced beyond the original contract price, or the contractor for them would have met with serious and heavy losses, and the completion of the work would have been delayed.

Again, in section contracts, the number of contractors must of course be multiplied. Multiply the number of contractors and you increase the expense of doing the work. A contractor who is sufficiently responsible to take a section, and particularly if a large one, cannot devote his time to the superintendence of the operations, as he must attend to his financial arrangements, he is therefore compelled to employ a superintendant for that purpose.

Under general contract a similar superintendant would be employed and the contractor would take a general supervision of the whole work, doing on each section, that which each section contractor, would have to do for his own portion.

The New Bedford and Taunton railroad (20 miles in length,) was originally divided into 15 sections, and was proposed for in the usual manner, that is, in sections. It was optional with the directors, whether they should accept propositions which would have given a contractor for each section, or have taken one company for the whole work. The Engineer advised the latter mode, which was adopted, and the result has proved entirely to his satisfaction, the advantages it has over the section contracts.

The work was completed, and opened upon the day named before it was commenced, and embodied in the contract. And no advance of price has been made, or required by the contractors, for any part of their work, which consisted of the entire graduation, masonry, bridging, laying of rails and superstructure, and the hauling and distributing materials for the latter.

If we had given the work out in sections, and had a contractor for each, as well as many others for masonry, bridging, rail laying, etc., I should then have had to give instructions in relation to the work, to all of these different men, and look to them for the fulfilment of them.

In the increased number of contractors, will be found a fruitful source for the clashing of interest.

The section contractor has no interest in the work beyond the completion of his own section, and frequently delays or pushes it beyond the interest of other portions of the work; for instance, if he should have a small section on one work, and obtains a larger one on some other, (which frequently occurs,) his desire would be, to complete his small one as soon as possible, to give more of his attention where his greatest interest lies; he will then increase the pay for labor, to attract a large force to his work, which, the moment it is done, creates discontent upon the entire length of the line.

Under general contract, the forces of the contractor, can be so arranged as to forward such parts of the work as most need expedition, and to do so without an injurious tendency to other portions of the line.

Great advantage was found in giving the hauling of materials for the superstructure and rails to the same general contractor, for he could arrange his work in such a manner as to keep the forces (which otherwise would have been stopped by the frost in the winter months,) at work, in transporting those materials. And the transportation could be done by him before the entire completion of the graduation—which could not have been done under section contracts, as the section contractor would not allow the use of his embankment while still upon his hands, as any derangement must have been repaired at his own expense.

It is equally important that the contractor who lays the rails and superstructure, should transport the materials for the same, because claims for damages frequently arise, upon the ground that such materials have not been delivered and distributed precisely according to contract, as regards time and place; which may arise from several sources—caused by the de-

tention in the completion of the graduation or the masonry, or a bridge to cross a stream.

In the construction of our work none of these claims for damages have arisen, so unsatisfactory to the directors, and so annoying to the engineer; and he confidently believes that it is owing in great part if not wholly to the manner of letting the entire work in one general contract.

With great respect, I am your obedient servant,

STEPHEN S. LEE,

Engineer of New Bedford and Taunton Railroad.

August 12th 1840.

We have seen a case precisely resembling the instance adduced above. A highly respectable contractor offered to undertake the whole construction of a short road. The price at which he offered was fair and rather below the average of the prices at which the various sections were finally let. The consequence was that those who had the best work completed it at an early date; the money was paid, and great profit resulted to the contractors. On the unfavorable sections, the work was abandoned, and before it could be resumed the price had to be raised far above that originally offered for the whole road.

We understand that Mr. William Norris of Philadelphia, has closed a contract with the Emperor of Russia, for 200 of his locomotives, at the price of $7,000 each, to be furnished in 5 years, at the rate of 40 engines each year. This is equal to $1,400,000,—a handsome item of exports for American labor in the mechanic arts.

MESSRS EDITORS—We are gratified in looking over the report of the Georgia railroad and banking Co. in your last number, to perceive that our labor in classing the repairs of roads, cars, engines, &c., of the New England roads has been serviceable to this company, in comparing the expenses per mile, with the three first named in the table. It should be taken into consideration, that in our northern climate, the frost, during our severe winters, tends to displace the rails, and as a natural consequence, their adjustment in the spring, is expensive. It is gratifying to perceive the details in the report of Mr. Thompson of the cost, and working of this road. We trust, ere long, the several railroad companies will class and reduce their expenses to *a system* under the several heads viz. for construction, motive power—repairs to road, cars, and locomotives—distances run by each engine—the incidental expenses classed. Very important results may be arrived at by comparing the several items—the kind and weight of the flat bar, or entire iron rail should be stated. The length of road—turnouts, whether single or double track. Very erroneous information of the cost of certain railways has been promulgated by the table published in the Housatonic railroad report of 1838.

J. E. B.

RAILROAD TRAVLLING.—The New York American says that 138,030 were conveyed on the Harlem railroad in the month of August last, and asks—

"Is there any railroad in any part of the world known to have received fare from this immense number of persons? It is at the rate of one million six hundred and fifty-six thousand per annum."

We answer yes. The London and Blackwall railroad conveyed in three and a half weeks, from the day of its opening, July 6, to July 24, 146,066 passengers, from whom it received fare. The same road, there is little doubt, conveyed double that number of passengers in the month of August, as on the 1st or 3d of that month, the second line was to be opened, and the trains were to run every quarter of an hour through the day—the first line previously opened, having proved entirely insufficient to accommodate all who applied.

The London and Greenwich railroad, also, in the month of July, conveyed more than 140,000 passengers, who paid fare amounting to more than 4,500*l*

In addition to the foregoing extract from a Boston paper, we would refer to our last number, page 153, where we find the Dublin and Kingston railroad of one mile in length, has carried over it, during the period it has been in operation, 26,410,150 passengers with only "3 deaths and 2 contusions to passengers," being nearly in the ratio of 1 to 5,000,000. We have not the number carried on the Paris railroad. We are informed that during some "gala days," half the number carried in one month over the Harlem railroad, have been conveyed to and from Paris in one day.

We are requested to republish the following communication, showing the progress of our population, and for the purpose of keeping in view valuable calculations as to the prospects of this great city.

If from the past we may judge of the future, New York will contain upwards of a million inhabitants in 1865, so that in 27 years from this time, there will be wanted three times the present number of houses to accommodate the citizens, and if this be correct, there is no good reason to despair of good prices for real estate.

NEW YORK CITY—A PEEP AT THE FUTURE.

New York, Nov. 26, 1836.

Gentlemen—Having of late seen with much pleasure, several interesting articles in your paper, on the subject of real estate on this Island I take the liberty of sending you for publication a calculation of the prospective increase of the population of the city of New York, during the present century, which was made in the year 1805, and published in the city newspapers at that time, merely premising that the author of this calculation, who at that early period so correctly estimated the advantages of our position for a great commercial city, still lives to behold his prediction realized, from year to year, with an accuracy truly wonderful. This calculation appeared in an article of which the following is a copy:—

"*Statistical.*—By the enumeration of the inhabitants of this city, (referring to the census of 1805, then just completed,) the progress of the population for the previous five years appears to be at the rate of 25 per cent. Should our city continue to increase in the same proportion during the present century, the aggregate number will, at its close, exceed that of any other city in the world, as will appear from the following table:—

1805	75,770	1855	705,650
1810	94,715	1860	882,062
1815	110,390	1865	1,102,577
1820	147,987	1870	1,378,221
1825	184,984	1875	1,722,786
1830	231,228	1880	2,153,470
1835	289,035	1885	2,691,837
1840	361,293	1890	3,364,796
1845	451,616	1895	4,205,994
1850	564,520	1900	5,257,493

"From this table it appears that the population of New York in 1865 will considerably exceed the reputed population of the cities of Paris and London. Cities and nations however, like individuals, experience their rise, progress and decline. It is hardly probably that New York will be so highly favored as to prove an exception. Wars, pestilence, and convulsions must be our lot, and taken into calculation. With every allowance for the numerous ills that life is heir to,' from our advantageous maritime situation, and the increase in agriculture and commerce, our numbers will, in all probability, at the end of this century, exceed those of any other city in the world, Pekin alone excepted. From the data here furnished, the politician, financier, and above all, the speculator in town lots, a subject to our shame be it spoken, which absorbs every generous passion, may draw various and interesting inferences."

More than thirty years have elapsed since the above article was given to the public, and the sequel has fully proved that the writer understood his subject well, and founded his calculations on correct principles. I have taken from William's Register a statement of the population of the city from the close of the seventeenth century down to the present time, to enable your readers to compare the above calculation with the actual results which the brief space of one hundred years has brought about in the aspect of our city, to which I subjoin a statement of the inhabitants of Brooklyn, as that city may now with propriety be considered as forming a a part of New York.

POPULATION OF NEW YORK.

In 1696	4,302	1805	75,770
1731	8,628	1810	96,373
1756	10,381	1815	
1773	21,876	1820	123,706
1786	23,615	1825	166,086
1790	33,131	1830	202,589
1800	60,489	1835	270,089

POPULATION OF BROOKLYN.

In 1810	4,402
1820	7,175
1825	10,795
1830	15,390
1835	24,529

Total population of New York and Brooklyn in 1835, 294,618.

By a comparison of the number set down for the year 1835, in the above calculation, with the actual census of that year for New York and Brooklyn, taken together, it will be seen that the views of the calculator, visionary and extravagant as they may have been regarded at the time they were published, fall short of the actual result by about 5000; and that his entire calculation, although a little overated for some of the previous

intervening periods, in which either war, (in 1812) or pestilence, (the yellow fever in 1822, and the cholera in 1832,) the contingencies which he referred to, actually occurred, is fully sustained and borne out by the test of thirty years, or nearly one third the whole time; evincing a knowledge of his subject and a correctness of judgment which deservedly entitle his views to much weight in estimating the increase of our city for the next thirty years to come, at the expiration of which time it is not unreasonable to calculate on a population of a million.

It would seem that in the year 1805, the spirit of speculation in town lots prevailed to as great an extent as at the present day. But if the progress of thirty years has realized not only the views of the philosopher and statesman, but also the most sanguine expectations of the financier and speculator, may we not with some confidence rely on the fulfilment of the past as a sure and safe presage of what the next age will accomplish in the growth and extent of our city, and in the increasing value of real estate on this and Long Island?—*Express.* CLINTON.

BRITISH AND AMERICAN MARINE ENGINES.

In the April number of the American Railroad Journal is a communication, in which the author attempts to make a comparison of the consumption of fuel between "the British engines which use low steam, and some of the engines of the fastest running American boats," the particulars of which are given in a table. From this table I wish to select, as the subject of my present remarks, the steamboat Rochester, for the reason that an estimate of the power of the engine of this vessel is also given in the April number of the London "Civil Engineer and Architect's Journal," in comparing the amount of power in proportion to the immersed cross section of the vessel in British and American steamers.

In the table mentioned above, the author states the power of the Rochester's engine equal to 160 horses; but the writer in the Civil Engineer gives as the result of his estimate the power equal to 985.463⅓ horses. Here, certainly, is no small discrepancy.

One reason of this great difference may probably be found in the different objects which appear to be kept in view by these two writers. The author of the first named, judging from the general tenor of his remarks, wishes to prove the superior economy of the British marine engine, when compared with the marine engine of this country; the object of the latter is to show that "the London engineers are not only capable of constructing engines which would propel vessels at the rate of 16.55 miles an hour, but they can obtain that result with less than $\frac{9}{11}$ths the power employed by their transatlantic brethren." And it must be allowed that both have succeeded most admirably. Having made these few preliminary observations, I shall now attempt—

1. To exhibit the different result that will be obtained in both cases, by applying the power of the engine as given by one of the writers, to the object (which appears to be) kept in view by the other; or in other words, in comparing the British and American marine engines with regard to their economy in the consumption of fuel, we shall suppose the power of the Rochester's engine to be 985.463 horses power, instead of 160 horses power; and in comparing the amount of power in proportion to the immersed cross section of the vessel, *vice versa.*

2. To give an estimate of the power of the Rochester's engine that shall approximate somewhat nearer its *true power* than either of the foregoing.

3. To make a more correct comparison between the British and American marine engines with respect to their economy in the consumption of fuel.

And first, the amount of wood consumed by the Rochester, as given in the table, is three cords per hour; which is considered by the author equal to 3290 lbs. Liverpool coal; which, divided by 160 horses power, gives 20.56 lbs. coal per horse power per hour; whereas the Great Western is stated to consume but 6.75 lbs. and the Liverpool 5.75 lbs. per horse power per hour; but if we divide the 3290 lbs. by 985.463, we have 3.34 lbs. per horse power, per hour, which instead of being $3\frac{1}{2}$ times the amount consumed by the Great Western and Liverpool, is but about one half.

Again. The writer in the Civil Engineer, in comparing the power of the British steam vessel Ruby with that of the Rochester, arrives at the conclusion that the gross power required to propel a vessel of the size of the Rochester at the same velocity at which she is driven by her present engine would be, if built on the same plan and as perfect as those of the Ruby, 892.46 instead of 985.463 horses power; or in the words of the author, "the amount of power absorbed by friction, and other losses, is thus on the principle of the Ruby's engines 185.19 horses power, and on that of the Rochester 397.03 horses power." But if we assume the power of the Rochester's engine to be equal to 160 instead of 985.463 horses, as stated by this author, the result will be as follows:—

The area of the Rochester's immersed midship section, as given by the writer in the Civil Engineer, is equal to 96 square feet; and that of the Ruby 65.6 square feet. $\frac{65.6 \times 160}{96} = 105$ horses power, required to propel the Ruby at the same velocity at which the Rochester is driven. But the speed of the Rochester is 16.55 miles per hour; whereas that of the Ruby is but 13.5 miles. Then the power of the Ruby will be less than 105 horses in the ratio of the cubes of their respective velocities, or $\frac{13.5^3 \times 105}{16.55^3} = 81.3$ horses power, instead of 100 horses, the power of the engines by which the vessel is now driven; consequently there is 18.7 horses power lost in the Ruby's engines above the amount that would be lost were the engines of the same construction as that of the Rochester, either from greater friction or malconstruction.

The results of the above calculations certainly appear very different from the results given by the respective authors, and are probably quite as near the truth.

In estimating the power of the Rochester's engine, the data that we shall make use of are either received from the engineer of the vessel, or the result of personal observation; they also refer to the time when the Rochester had a cylinder of 43 inches diameter; this has since been taken out, and replaced by one of 50 inches diameter.

The cylinder is 43 inches diameter, the area of which is 1452.2 square inches, with a stroke of 10 feet, and the crank makes 25 revolutions per minute; hence the velocity of the piston is equal to 500 feet per minute. The pressure of steam maintained in the boiler above the pressure of the atmosphere is 45 lbs. per sq. inch; to which add 11 lbs. for the vacuum upon the opposite side of the piston, we have 45 lbs. $\times$ 11 = 56 lbs. per square inch for the gross pressure upon the piston. The engine working expansively, the steam is cut off at 38 inches, or allowing two inches for the clearance of the piston and space occupied by steam in the steam chest, say 40 inches or one-third of the stroke, the average pressure will then be

31.6 lbs. per sq. inch nearly; but from this we must deduct say 2.6 lbs. for the loss by the wire-drawing of the steam and maintaining the cylinder at the temperature of the steam which enters it from the boiler, also 9 lbs. per sq. inch for the friction of the engine, we have then $31.6-(2.6\times9)=20$ lbs. per sq. inch as the whole effective force of the steam upon the piston.

If then a=area of cylinder, p the effective pressure upon the piston in lbs. per sq. inch, v the velocity of the piston in feet per minute, and h the value of 1 horse power in lbs. raised one foot high per minute, the power of the Rochester will be $=\frac{a\,p\,v}{h}$, or substituting the known value of these quantities, we have $\frac{1452.2\times20\times500}{33.000}=440$ as the horses power of the engine, which is probably not far from the truth.

We now come to the comparison between the British and American marine engines in point of economy in the consumption of fuel. And here also the data with respect to the Rochester were received from the engineer; the particulars of the Great Western and Liverpool are extracted from the table mentioned in the first part of this article.

Name of the Vessel.	No. of Engines.	Diameter of Cylinder.	Length of Stroke.	Power in Horses	Cords wood pr. hr.	lbs. per hour Liv. coal.	lbs. coal pr. hr. pr. horse power
Rochester	1	43 in.	10 ft.	440	2.4	2400	5.48
Great Western	2	$73\frac{1}{2}$ in.	7 ft.	4[illegible]0		2700	6.[illegible]
Liverpool	2	75 in.	7 ft.	460		2645	5.75

We have here assumed one cord of wood equal to 1000 lbs. Liverpool coal, as this has been found from experiment very near its true value. It will be seen from the above, that if the consumption of fuel in the Rochester be called 1, the ratio of the Liverpool is 1.047, and the Great Western 1.25.

In attempting to make the foregoing comparison of the consumption of fuel, I have selected the Rochester, as in the table given by the writer in the American Railroad Journal the consumption is shown to be greater on board this vessel, in proportion to the power, than any other mentioned.

As before stated, the amount of fuel consumed on board the Great Western and Liverpool is taken from the table mentioned; but this amount is not so great as the actual consumption on board these vessels by about 300 lbs. per hour.

If not extending this article too much, I may perhaps here be allowed to state for the information of the writer in the Civil Engineer, that in the American practice there is no nominal horse power given for marine engines, by which to be able to compare them with others; but contracts are made for some given diameter of cylinder and length of stroke; and in some cases the dimensions of the boiler or boilers are also specified.—*American Repertory.*

MIRON.

Philadelphia, July, 1840.

REPORT.—TO THE STOCKHOLDERS OF THE SOUTH CAROLINA CANAL AND RAILROAD COMPANY.

The accounts by the Secretary and Treasurer are herewith presented. Paper A. contains the general accounts of the Company for the half year ending the 30th June, 1840.

Showing the income of the half year to be $223,295 46

The expenses for the same time including all improvements in road, machinery and buildings, and the interest on loans, 152,213 80

Making the nett income $71,081 66

Over 7 per cent. on the capital. This amount has been applied to the reduction of our debt to the Louisville, Cincinnati and Charleston railroad company.

Since the first of last January the drafts of that company have been accepted to the amount of $110,259 56

First to assist in payment of the last instalment for the purchase of the stock in this company, $60,000; and secondly to provide for the payment of the interest on the sterling bonds ($2,000,000) of that company, $50,259 56

All of which has been paid except $14,543 57, falling due this month, on which we will require accommodation until the fall business commences—as the income through the summer will barely meet the current expenses; in previous years it has not done it.

Besides the above payment to the L., C. and C. Railroad Co. our debt has been further reduced by charging the transportation of iron, &c., and chairs and spikes furnished to that road, $22,233 37

The accounts continue to show the pleasing fact, of an increase of income, while the expenses have continued to decrease.

The whole income for the six months, ending 30th June, 1840, is $223,295 46

For the corresponding months of last year it was 198,571 20

Showing a gain of $24,724 26

The expenses for the same time last year, were $175,882 17

For the corresponding months of this year, are 152,314 80

Decrease in expenses of $23,668 37

Added to increase in income, is $48,392 63

Making a total gain to the first half of the present year, over the first half of the last year, of forty-eight thousand three hundred and ninety-two dollars sixty-three cents.

It is proper here to state how it happened that the expense of this company up to July, 1839, continued to increase, and since that time have been diminishing.

In the winter of 1835-6, it was found by John Ravenel, Esq., then President, that without a much larger expenditure in labor and materials, the road could not be kept up; consequently arrangements were made for an increased quantity of timber, and an additional number of hands organized under competent carpenters, till a force was made equal to re-build the superstructure of the road in three years, and by the expiration of that time, say in July, 1839, the improvements and repairs had made the road nearly equal to new. The road thus improved, it was found to be practicable, in the course of the last year, to reduce the expenses in labor and materials—equal to replacing tne timber in the road one-fifth in each year—or to rebuild in five years. The lower rate of labor and provisions, and material generally, have also contributed to lessen the expenses of the last six months.

The following papers are also furnished by the Secretary and Treasurer:

A table (marked B.) of passengers and freights, passed on the road each month, with number of bales of cotton transported.

A statement (marked C.) of the whole property of the company, with the road and all its improvements—the whole costing———

And a compartive statement (marked D.) showing the receipt for each year, since the opening of the road.

The increase of receipts on the road, since it was fully in operation, say for the last six years, has been over 20 per cent. each year, to the next preceding.

The gradual increase of income, and expenses diminishing—and the condition of the whole property annually improved—gives a character to the establishment that should enlist great confidence in the future prosperity of the company, and is calculated to excite speculation in those who look at the matter understandingly.

A report from the superintendant of the road, Mr. Lythgoe, (marked F.) makes the ordinary repairs, for the last six months, $28,034, and the improvements, wood and extraordinary repairs $18,483. Showing the ordinary repairs to be $412 per mile per annum. The estimate for the current six months of repairs and improvements is $36,000.

A paper (marked G.) furnished by Mr. Ross, master of machinery, details the number and condition of the Engines; statement of the machinery in the shops, and kinds and materials on hand.

The machinery has been kept up without the purchase of additional engines. By re-building and constructing in our own shops, a sufficient number have been kept in order the last six months, and it is believed we shall have as many as will be required for the business of the approaching season.

It appears by the accounts, that the quantity of materials and amount of labor in the shops has been greater in the last six months than in the first half of last year by $3,501 30

While the charge for the machinery has been less in the same time, by $12,690 90

Showing a saving of $9,189 60

We cannot refrain from adverting to this fact again; we did in our last report; the great importance of having our work done at home, as far as practicable.

Spending the income of the company at home instead of abroad, is equal at least to half of all the other advantages of the institution. The same community receiving the payments that make them. Hence the amount paid out still remains with us, and goes far to sustain those whom we look to to sustain us.

Improvements have been made to considerable extent. Buildings and sheds have been erected, covered with some 150 squares of tin roof—1st, extending over the freight cars while loading; 2d, to cover engines repairing and building; and 3d, in which are building passage and freight cars; 4th, to make boilers in, &c.

In machinery and cars, the following improvements are worthy of notice:

The use of steeled journals, and *chilled cast iron* boxes, instead of *brass or composition* boxes, on iron journals.

These have been in use constantly since November, 1838, under one of the passage cars, and have been applied to all the others, as well as the baggage and freight cars, on eight wheels, since that time—and have in no instance yet worn perceptibly—saving nearly the whole expense of renewiug boxes and journals on the old plan.

These steeled journals and chilled boxes have been manufactured and furnished to us by the New Castle Manufacturing Company, at New Castle, Delaware. We hope soon to be able to get them up here—we have already made some progress.

Another improvement, of perhaps greater importance, and which has originated with ourselves, is the *barrel car*—constructed both for passengers and freight. These are made with staves grooved and dove-tailed together, and supported by six iron hoops 2 inches wide, by half inch thick—doors at both ends. The passenger car is 30 feet long in the clear, with portico at the ends $2\frac{1}{2}$ feet long. The diameter in the centre is 9 feet, and at the ends 8 feet. The staves are $1\frac{1}{4}$ boards 5 to 6 inches wide extending the whole length of the car. There are 20 windows on each side, 15 by 30 inches, glazed—the sash passing up over head. The freight car, which has been in use about four months, is only 21 feet long—but others are being constructed 30 feet long, and will carry about 40 to 45 bales of cotton, or 15,000 lbs. other goods.

This plan originated in an inquiry made by Col. Gadsden, in September 1839, before he was connected with the company, except as a stockholder,—whether a car made of the barrel, or hogshead form, would not answer for freight? To which we assented—and although this occurred casually while travelling on the road, we determined, on returning to town, to have a car constructed of this kind—and the arrangements and details were made by Mr. Hacker, the master carpenter, and myself. Mr. Hacker, while building this car, suggested the plan of a passenger car, which he proposed to get up; and did so, he and myself arranging the details.

Col. Gadsden having since become the President of the L., C. & C. R. R. Company, has concurred with me in awarding to Mr. Hacker the invention of the passenger car, of the barrel form, and assented to his taking out the patent—he renouncing to both of our companies the right for this State. I have been thus particular in this statement, that the facts may be presented, least any difficulty should occur respecting the patent rights.

These cars, we believe, will be invaluable to the company, and to others who use them, being much lighter, cheaper, and more durable than the square form.

The preparation of Timber in Corrosive Sublimate to preserve it.

This process has become not only a matter of speculation, but of interest, from the progress of experiment we have made. Besides the timber prepared and put in the road last year, and mentioned in our report (says of "130 pieces 20 feet long as ties, under both tracts of the inclined plane, supporting the butt joints of the rails—and 50 pieces also put in the road on the lower part of the 23d mile") on the 9th of July, 1838—four pieces of rail timber, cut from one stick, each $6\frac{1}{2}$ feet long, and about 9 inches square, were put in the road as rails. Two of these pieces were prepared in a solution of corrosive sublimate, about 15 days—the others were unprepared. On the 17th June, 1840, these pieces of timber, which lay about two-thirds of their thickness under the ground, were examined by Col. Long, U. S. C. E., Col. Gadsden, Mr. John Ross, master of machinery, and myself. We found the prepared pieces perfectly sound, but those unprepared were decayed in several places, some an inch in, from the outer surface. The earth was returned, and the timber left as found for further examination in future years.

In the above, we have all the proof in favor of the process that could be had in two years. If at the end of five years these prepared pieces remain sound, the expenses of Kyanizing will be well repaid. If sound that

length of time, it will remain so, no doubt, sufficiently to sustain the iron on it, as much longer, say ten years. Although the calculation is, that unprepared timber will remain in the road an average of five years, yet it is known that considerable signs of decay are discovered in less than half that time.

These remarks are induced at the time, by noticing a report of the Secretary of War to the Senate of the U. S. in answer to an inquiry on this subject in which were very few facts of interest, of experiments in this country, and nothing so satisfactory as our experiments here.

The increased price charged for passage the last three half years, has done much to sustain the expenses, and begins to show something like an interest on the capital employed, which, however, cannot be paid to the stockholders while the company is in debt. But it will reduce the cost of the road to the original capital, and afford a greater per centage of dividend after the debts are paid.

It has been found in other States, and also in Europe, that railroad companies have been compelled to ask a higher rate of toll. The Legislature of Virginia, in March 1840, permitted the Petersburg railroad company to advance the price of passage to 8 cents per mile, and to add about 50 per cent. on the rate of freight. (*Mr. Bird's report in May.*) And the government of Belgium, on the 3d of February, 1839, advanced the tolls on all the roads in that kingdom, (10 in number) from 1f. 43c. to 2f. 06c., being about 45 per cent. advance—without this, their productiveness was a matter of doubt. In fact, the old tariff is stated to have been ruinous. But the increased rates are said to have made these works profitable.—(*Railroad Journal,* 15*th June.*)

Since the annual meeting in January, little has occurred beyond the ordinary business of the company, unless we record the fact of the great freshet of the 27th and 28th May last, which did much damage to our road at Hamburg. About 800 feet of the superstructure was swept away, (the iron has since been recovered) and some thousand yards of the embankment washed down. The rails were soon replaced on the piles. The mail and passengers were only delayed while the water was actually over the road, and freight was passed over a few days after. The repairs are now about completed—the embankment better than before. The cost will be about $3000, but as the materials and labor were borrowed from other parts of the line, the expense will not be felt, or hardly perceived in the accounts. Other parts of the road beyond the inclined plane were considerably washed, but not enough to require immediate attention. They will be repaired as soon as the hands can leave Hamburg.

The present condition of the road, as a whole, was never better than it is now. The speed attained is equal, if not greater than on any part of the great mail route from Boston to New Orleans. There is, perhaps, no other point where the mail is passed over 136 miles in less than 9 hours—our trips are frequently performed in about 8 hours. There being over two hours necessary delays,—the performance of the engine is over 20 miles an hour while running.

The superiority of the peculiar construction of our road—the superstructure on piles driven in the ground and embanked afterwards—was shown very satisfactorily in the repairs, after the great flood of the Savannah river, in May last, which raised the water five feet over the top of the rails, yet not one-fourth thus covered were removed, and had it not been for the great weight of timber, houses and whole trees, which were forced against it with great violence, no part would have been dislodged from its foundation.

The plan, regarded by many as a great mistake, in the building of the

road, has proved an economical one, as well in repairs as in original construction.

The report of the agen of Transportation, captain Robertson, (marked E.) after giving a statement of the number of cars in this department, and some facts that have occurred since the first of the year, recommends the extension of our road over the Savannah river at Augusta, and the purchase of negroes to supply the place of those we hire. These are both popular measures, but such as I cannot accede to. At present I do not think it advisable to make any great outlay that would require an increase of capital. I am confident that a location in Augusta could not be one that would be profitable, and requiring a considerable expenditure of money, that could with difficulty be obtained—and if applied would not yield a fair interest. Such an extension of the road would add materially to the expenses of the company—the keeping up the bridge, additional ware houses, clerks, &c. Subjected too, as we should be, to taxes and other impositions, consequent on being beyond the limits of our charter.

My objections to the purchase of negroes for the line, or for the shops, are equally strong, and I doubt very much the policy of such a measure, even if we had the means to make the purchase.

The privilege of promptly dismissing an inferior, vicious, or otherwise worthless negro from our service, is a very great one, which would not be had if they belonged to the company. It is also important to have the eye of an owner to look to the treatment as well as the conduct of the slaves. If the company owned them, the overseers might be cruel to them without redress; and it could not be expected they would attend much to their habits. But it is different where there is a master to appeal to, or to inquire after them, who feels nearly the same for them,he does for his children, besides the protection of their value, which is a great stimulant to see they are not abused.

And as regards the employment of negroes, in the shops and on the engines, I think it very improper to instruct them in the arts and facilities which might be used by them against their owners, as well as for them. It seems to me that every large institution of this kind should do all in its power to add to the physical force of the country, by employing, where applicable, able-bodied white men, thus giving strength to our militia, patrols and police generally.

In legislating for an establishment like ours—one which we hope may be so conducted as to be preserved for ages—no small consideration of gain should conflict with the safety or security of the property, or good morals of the country in which it is located.

Respectfully submitted,

T. Tupper, *President.*

Note.—An engine and crew has been, by request of Col. Gadsden, put on the branch road to Orangeburg. The receipts on that road credited to the Lu., Cin. and Ch. R. R. Co., and the expenses of the engine charged to that company.

Another Anthracite Furnace.—Mr. John Pott, of the West branch valley, has converted his furnace into an Anthracite furnace. She was blown in exclusively with anthracite coal, about two weeks ago, under his own superintendence, and continues to make excellent iron, yielding from 10 to 12 tons per peek The furnace is of the smallest class, and the yield, with the use of anthracite, is greater by two or three tons per week, than with the use of charcoal. This makes the *seventh* anthracite furnace in blast in this country.—*Miners' Journal.*

We insert the following communication, although unfinished, as it bears upon various articles already published in the Journal. At the conclusion of the subject, if necessary we shall offer some remarks.

ON THE STEAM ENGINE. ON THE APPLICATION OF STEAM AS A MOVING POWER, CONSIDERED EXPRESSLY WITH REFERENCE TO THE ECONOMY OF ATMOSPHERIC AND HIGH-PRESSURE STEAM. BY GEORGE HOLWORTHY PALMER, M. INST. OF CIVIL ENGINEERS, LONDON. INSERTED IN THE AMERICAN RAILROAD JOURNAL FOR MARCH AND APRIL, 1840.

TREATISE ON THE STEAM ENGINE. BY JAMES RENWICK, L.L.D., PROFESSOR OF NATURAL PHILOSOPHY AND CHEMISTRY IN THE COLUMBIA COLLEGE OF NEW YORK. SECOND EDITION, REVISED AND ENLARGED. 1839.

There are few subjects of equal interest or importance, that have been more discussed than the proper use and economical application of steam as a moving power; yet there is probably no subject on which so many discordant opinions still exist among practical men. It necessarily follows, then, that the subject is not sufficiently, because not clearly understood. Contradictory and erroneous opinions are not only held by those whose opportunities for observation or capabilities for comparison have necessarily been limited by circumstances or education, but are adopted and supported by well informed individuals like the above, who from their peculiar position in society might be reasonably deemed competent judges and infallible authorities, from possessing leisure and the most ample means for investigation; and having seemingly exerted themselves to the utmost, have nevertheless arrived at the most opposite, and as we shall hereafter show, at equally unsound conclusions—both equally positive—alike erroneous. Theoretical writers ever seem to look at facts according as they favor preconceived opinions, rather than as aids to truth and the only sure guides to proficiency; while the facts themselves are left to be developed by the patient practical mechanic, who, from his limited knowledge, is after many anxious trials the frequent victim of disappointment or loss, or the unthanked and unrewarded instrument of useful improvements—unsuccessful, reviled; successful, defrauded.

The intention of Mr. Palmer, as deduced from his paper, is to discredit the truth of the reported duty of the Cornish pumping engines, and to totally deny the great value of high steam when used expansively in those or any other engines; for he says, (p. 183) "How then a saving of fuel can arise from the use of high-pressure steam worked expansively, is to me an evident paradox; unless by some power utterly beyond my comprehension, the sensible caloric can be prevented from becoming latent by dilatation, which, I need scarcely add, no power can accomplish."

Prof. Renwick, on the other hand, not only admits the truth of the Cornish reports, and the great value of high steam when thus applied, but recommends its general adoption in steamboats, &c., in a manner and to an extent which it is one of the express purposes of the present paper to show is dangerous and unnecessary; and being so, is impolitic; and the reason for these assertions will be hereafter apparent in this our endeavor to separate prejudice from intelligence, by the substitution of certain facts for uncertain theories or groundless conceit.

If Mr. Palmer's treatise (having been published by the London Institution of Civil Engineers) is to be considered as possessing the approval of that respectable institution, and his arguments as having obtained their sanction,

then the work must be considered one of the most extraordinary ever recorded by a society of practical men; its sole purpose being to ridicule and to discredit, by most labored theoretical and unfounded speculations, (by any thing and by every thing but facts) the published monthly reports of the duty of the Cornish pumping engines, and to prove by an immense collection of heavy and unsound arguments that it is physically impossible the Cornish reports can be true; while, unluckily, it will be seen Mr. Palmer having been physically mistaken, the society will have lost all the credit and honor anticipated in this publication of what, Mr. P. says, is "above his comprehension."

Prof. Renwick, on the other hand, too ingenuous to deny such public and authentic statements, and too well informed to question them, has elucidated in detail the causes of the superiority of the Cornish engines; and these causes are no where better described than in his work; (see articles, 110 to 115.) But as he has also mistaken the nature of steam and its value; as he has also too hastily, though ingeniously, assumed that improvements so palpable and so useful in the Cornish pumping engine, can be as readily imparted, and as extensively and usefully applied to the rotary or crank engines, he has thus promulgated errors; which being sanctioned by his respectable name, supported by his otherwise useful work, may be attended with very injurious effects to the future improvement of the steam-engine, and discredit to the national talent.

Hence then, were we to inquire for the causes for these opposite views and the contrary deductions of these writers, we should probably first seek it in the actual difference to be found in the action of steam in the pumping engine and in the crank engine—an important fact; unknown to each, because unnoticed by both; and yet it is a fact of no mean importance to any one attempting a description of the steam engine, and of great importance to any one attempting its improvement; and if we were to extend our inquiries in a full and unprejudiced manner, we probably should soon discover sufficient additional cause for their opposite views in the many different opinions that have prevailed on the nature and essential properties of steam, and which have originated and continued very singular and capricious prejudices.

It is well known that the most extraordinary and incredible properties have been attributed to steam by earlier writers, who unhesitatingly asserted that while the expenditure of fuel increased in an arithmetical, the force of steam increased in a geometrical ratio. Hence the most extravagant advantages were expected and promised by Evans, Perkins, and Wolfe; advantages, unfortunately, which could never be realized, because they never existed.

If we inquire further, how such talented men could ever have been thus mistaken, we may find their best, and perhaps only excuse, in the seeming vastly increased effect of heat on the thermometer, as indicated in the tables published by chemical writers on the elasticity of steam. Thus Dr. Ure states, though the temperature of water must be raised 180°, or from 32 to 212, to produce steam equal to 30 inches mercury, that only

36°	are required	from	212 to 248	to equal	30 inches	mercury.
24°	"	"	248 to 272	"	"	"
18°	"	"	272 to 290	"	"	"
15°	"	"	290 to 305	"	"	"

MM. Dulong and Arago carry their tables to fifty atmospheres, and state that towards the end of their observations a *single* degree of heat increases the elasticity of steam equal to thirty inches mercury. Now, this seeming great effect of heat on the thermometer, indicating intensity only, was

doubtless mistaken for quantity; and increased power was thence inferred without further inquiry. Hence there arose the unfortunate delusion that overwhelmed so many minds for so many years; and this baseless speculation has unquestionably hindered the application of rational and practical, because apparently less splendid endeavors; and hence the improvement of which the steam-engine is still susceptible has probably been retarded, and is still thereby prevented.

These overexcited opinions have generated and still maintain in this country, as undue a prejudice in favor of high steam, as the unfortunate failure of the hopes they gave rise to has created an equally undue prejudice in favor of low steam in England, over a great portion of the most influential practical engineers, of which sufficient and indubitable evidence is given by this publication of Mr. Palmer's speculations, sanctioned by the British Society of Civil Engineers.

Hence then we have obtained the probable origin of the very opposite opinions embraced and prejudices exhibited by the writers at the head of this paper, on a subject, mechanical and physical, and therefore as certainly susceptible of such full explanation as will allow of neither dispute nor misapprehension, whenever it shall be fairly and carefully investigated, without national prejudice; which, mean and pitiful as it is on personal subjects, is miserable on this.

The first inquiry in this matter should now be, as it always should have been, what is the real nature of steam of various densities? as so many opinions have been given, and are still maintained thereupon, and as a previous knowledge of the true properties of steam is evidently as attainable as it is indispensable to a right discussion of its proper application. Its correct analysis will prove that all former and all prevailing errors have arisen from a want of that definite and certain knowledge of this branch—or rather root—of the subject; for contrary to all previous authorities we maintain, and will speedily prove, that steam in every proper state and density, when rightly applied to produce motive power, is a definite compound of water and of heat, ever in an active, sensible, or free state, and never in a latent, or insensible, or combined state, as it is in the permanent gases of oxygen or hydrogen; but a compound at once and always simple, wherein the rate of the elements is definite or invariable.

By proving this, we shall clear our subject from a load of superfluous arguments which each writer has based on erroneous and mistaken notions of this invariable property of steam; and as it is essential that we show this fact fully and clearly, we shall proceed to do so by an experiment which may be easily made or repeated, at little trouble or expense, by any of our readers. We shall detail it fully, to prove our position; and it will seem not a little curious that this experiment of ours differs but a little, in its detail only, from the experiment quoted by Mr. Palmer in the commencement of a paragraph, wherein he draws so melancholy, so unfounded, and such a contrary conclusion, which there appears to have been the source of his many errors. How easily, then, may such mountains be removed!

Provide a small wooden tub or cistern, with a moveable wooden cover; coil about 10 or 12 feet of very small leaden pipe, spirally on the bottom of the cistern, passing the ends of the pipe through, and cementing them into opposite sides of the cistern; connect the upper end of the pipe by a small stop-cock to a high-pressure steam-boiler. If then a full cubic foot of cold water is introduced into the cistern, its depth and temperature observed and noted, by a regulated opening of the stop-cock some exact measure of water may be distilled through this apparatus, (as a pint) and the

heat and water in steam of any and every density may thus be separated and correctly measured; as the distillation of a constant quantity of water by measure will always impart to the condenser one constant corresponding elevation of temperature, from steam of any and of every density, whether 1 lb. or 10 lbs. or 50 lbs. or 100 lbs. per inch above atmospheric pressure. The quantity of heat obtained from a constant quantity of water will be also always an invariable corresponding quantity.

Now, the true composition of steam of 1 lb. per inch cannot be misstated, when assumed to be steam of much higher elasticity greatly expanded; and as we have proved no heat is lost, or has become latent or insensible during the expansion of steam, contrary to the assertion so fully and so unreservedly made by Mr. Palmer, and as certainly though in a very reduced or humble degree by Mr. Renwick, yet equally erroneously by both—we see their joint errors are founded alike on a misapprehension of the true nature of the heat in steam, in which none can be lost or become latent with any degree of expansion within a steam-engine, because *heat never becomes latent in steam at all.*

Trusting that enough has been proved to show both the origin and excuse for the errors of the earlier writers, in their unfounded anticipations of unlimited advantages from the use of high steam, we will next endeavor to show the origin and excuse for the mistaken views of the authors at the head of this paper, and at the same time remove an incubus that has long pressed so heavily on, and retarded so much the advancement of this particular branch of science.

Probably in the first instance our observations will be met with doubt, or denial, or both, from many who are governed, as the greater part of mankind are, more by the authority of great names than by reason; as in the case now immediately contemplated, where a humble individual presumes to question the discernment and discrimination of every chemical writer and philosopher on the subject and nature of steam, from the time of the venerated Dr. Black to the present period. But although it may and doubtless will appear to most chemical readers an almost absurd position to question the assertion first made by Black, and since universally admitted by all writers on the subject, yet it must be allowed, *a priori,* that if an error has crept into the theory of steam on such high authority, and has been sanctioned so long a time, by so many learned and acute writers, and by such a host of talented and practical men, then the removal and exposition of such an error must be considered as an imperative duty devolving on the first individual, however humble he may be, that shall first and clearly detect it. Considering then this duty has devolved on us, we proceed to explain our views, by inquiring into the doctrine of LATENT HEAT, as expounded by that highly gifted individual Dr. Black, who taught that ice in melting absorbed 140° of heat; and that as the temperature of a thermometer embedded therein remains invariable during the whole period of melting, however long that period may be protracted, the great quantity of heat thus absorbed by the melting ice becomes latent, or hidden, or insensible; yet it is alone to this application of the latter term, or insensible heat, that no contradiction is or can be contemplated.

Again. When an immensely larger proportional quantity of heat is combined with the elements of water, to form the *permanent* oxygen and hydrogen gases, the term latent heat is more strictly applicable, because though the heat in combination exists in such a greater quantity, the gases may be exposed to an immensely greater range of temperature, or to any degree of cold, without disturbing the chemical and permanent arrangement of the heat with the ponderable elements in the gases. Now, we al-

low the term insensible heat to correctly designate the heat in melted ice or water, and the term latent heat as properly to designate the heat combined with the oxygen and with hydrogen, and forming those permanent gases, yet we are not only disposed to question the existence of heat as latent or insensible in steam, and the propriety of those terms, but to deny the existence altogether of any other than free heat in steam of any density whatever and wherever; for it is not perceptible to the sense of feeling, appreciable and measurable by the thermometer; and not only perfectly free, but ever prone or ready to enter into instantaneous combination with any colder substance with electrical rapidity, its speed limited alone by the conducting power or capacity of any such substance with which it comes in contact? Can any thing be conceived more contrary to reason than the idea that the heat in steam is ever latent or insensible? Can any thing be more contrary to sensation, to experiment and to fact?

Yet from views so mistaken, with arguments so unfounded, Mr. Palmer has not only attempted to retard the improvement of the steam-engine, but has had the hardihood to deny facts as notorious as the sun at noon-day. Well has he said, "it is above my comprehension." We can see no possible reason to doubt this his assertion; but we do see reason to doubt Mr. Renwick's assertion, article 115, "The expansion of steam is not inversely as the pressure is;" and we have two reasons for thus doubting Mr. Renwick: the first, founded on the fact we have proved, that the heat in steam is always free and active, and constant in quantity; and the second reason is deduced from an experiment easily made, and which we propose to describe in our next paper.—*American Repertory.*

The following statement of business done on the Georgia railroad, was omitted in our last number.

No. 8.—STATEMENT OF THE AGGREGATE AMOUNT OF BUSINESS DONE ON THE GEORGIA RAILROAD FROM 1ST OF MAY 1839, TO 1ST APRIL 1840. (ELEVEN MONTHS.)

Months	Passengers.		Freight.			Mails.	Total.
	No.	Amount.	Weight pounds.	Cotton bales.	Amount.	Amount.	Total Amount.
1839							
May	2,405½	6,647 91	599,561	247	2,681 73	1,277 83	10.607 47
June	2,071	5,482 58	358,674	101	1,936 44	1,277 83	8,696 85
July	1,823	5,165 21	377,544	70	2,260 89	1,676 83	9,102 93
Aug	2,109½	5,704 17	378,627	23	1,805 90	1,713 54	9,223 61
Sept.	1,609	3,394 23	720,581	190	3,191 17	1,713 54	8,298 94
Oct.	1,413	3,703 25	1,216,293	1,747	6,944 74	1,713 54	12,361 53
Nov.	2,331½	7,162 15	1,679,443	9,010	20,029 57	1,713 54	28,905 26
Dec.	2,481	7,568 98	1,378,246	13,043	22,608 01	1,713 54	31,890 53
1840							
Jan.	2,488½	7,176 12	791,427	12,805	20,534 14	1,713 54	29,423 80
Feb.	1,805½	5,455 34	624,579	5,899	11,919 09	1,713 54	19.087 97
Mar.	2,094½	6,045 27	693,085	3,200	7.508 57	1,713 54	15.267 38
	22.632	63,505 21	8,818,060	47,235	101,420 25	17.940 81	182,866 27
	Passengers Warrenton branch, freight train and extra trips,						306 68
	Extra baggage and specie,						890 80
	Freight between stations,						539 79
							184,603 54

No. 9.—STATEMENT OF THE EXPENSES INCURRED FOR WORKING THE GEORGIA RAILROAD FROM 1ST MAY 1839, TO 1ST APRIL 1840. (11 MONTHS.)

Transportation Department.

Stationary, printing, &c.,	$540 42	
Loss and damage,	1,528 02	
Incidentals,	1,009 54	
Oil and tallow for cars,	264 56	
Provisions, clothing, doctors' bills, and other expenses of negroes,	3,704 78	
Expenses of mules on Warrenton branch	330 23	
Wages of laborers,	4,145 71	
Agents and clerks,	6,845 57	
Conductors,	3,600 50	
		$21,969 33

Motive Power.

Stationary, printing, &c.,	$54 24	
Expenses of water stations,	2,758 62	
Incidentals,	64 46	
Fuel,	6,269 31	
Oil and tallow for engines,	2,849 77	
Ordinary and extraordinary repairs of engines,	4,733 11	
Loss from contingencies,	1,136 67	
Engineers and firemen,	6,896 75	
Provisions, clothing, doctors' bills, and other expenses of negroes,	1,378 29	
		$26,141 22

Maintenance of Way.

Men's wages,	$11,471 32	
Provisions, clothing, doctors' bills, and other expenses of negroes,	1,993 47	
Stationary, printing, &c.,	16 00	
Incidentals,	192 74	
Tools,	379 57	
Materials,	1,284 41	
Supervisors,	1,833 28	
		$17,170 79

Maintenance of Cars.

Repairs, &c.,	$4,525 00	
Wood work for two cars destroyed by accident,	440 00	
		$4,965 00
		$70,246 34

STATEMENT No. 10.

No. 10 Names of Engines.	Makers' Names and Classs.		Commencement of Service.	Number of miles run by each Engine, from 1st of May, 1839, to 1st of April, 1840.	Cost of ordinary repairs of each Engine, from 1st May 1839, to 1st of April 1840.	Cost of extraordinary repairs of each Engine, from 1st May 1839, to 1st of April 1840.	Total cost of Repairs of each Engine, from 1st of May 1839, to 1st of April 1840.	Total number of miles run by each Engine, from commencement of service, to 1st of April 1840.	Cost of ordinary repairs of each Engine, from commencement of service, to 1st of April 1840.	Cost of extraordinary repairs of each Engine, from commencement of service to 1st of April 1840.	Total cost of repairs of each Engine, from commencement of service to 1st of April 1840.	REMARKS.
Georgia,	Baldwin, Vail and Hufty.	No. 3	May 5, 1837		94 25		94 25	29380	1105 52	96 00	1201 52	In shop, und'ng. thor'gh repair.
Pennsylvania,		" 3	May 5, 1837	6068	339 46		339 46	34985	1673 53		1673 53	In house, in good order.
Florida,		" 3	Dec. 27, 1837	6035	426 04	97 43	523 47	21441	1327 87	97 43	1425 30	In house, in complete order.
Alabama,		" 3	Jan. 12, 1838	11525	468 99	56 85	525 84	32767	1064 18	273 42	1337 60	On road in good order.
Louisiana,		" 3	Feb. 2, 1838	19200	868 49	17 00	885 49	34597	1441 88	213 12	1655 00	In shop, underg'ng slight repair.
Tennessee,		" 3	May 29, 1838	12960	333 27	159 03	492 30	26794	689 61	193 98	883 59	On road, in good order.
Wm. Dearing,		" 2	Nov. 6, 1838	15455	373 19	109 32	482 51	23508	547 75	168 10	715 85	On road, in good order.
Virginia,		" 2	Dec. 24, 1838	12684	342 57	131 95	474 52	21540	601 84	261 19	863 03	In house, in complete order.
Mississippi,		" 2	Dec. 28, 1838	7615	66 97	463 65	530 62	11337	293 96	473 56	767 52	In shop, underg'ng slight repair.
Kentucky,		" 2	March 24, 1839	15660	395 21	55 86	451 07	15960	455 82	55 86	511 68	In house, in complete order.
W. Cumming,		" 2	Dec. 14, 1839	1615		19 83	19 83	1615		19 83	19 83	In house, in complete order.
James Camac,		" 2	Dec. 23, 1839	2025				2025				
				110842	3708 44	1110 92	4819 36	255949	9201 96	1852 49	11054 45	

The item of ordinary repairs, includes the cost of workmanship, materials and all new parts of the machinery procured from the North and used in repairs of each engine, exclusive of those caused by casualties. These are embraced in the item of extraordinary repairs.

MISSISSIPPI.—The large amount charged to extraordinary repairs on this engine was caused by the carelessness of the fireman, who fired her up without water in the boiler, by mistake, and destroyed nearly all of her copper flues.

☞ The amount of capital paid in, from Nov. 7, 1836, up to April 6, 1840, was $2,193,952 00.

The amount of dividends declared at sundry times during the same period, was $529,153 36.

We have frequently read, with great pleasure, reports such as those which follow, as extracted from the Journal of the Franklin Institute. We conceive this to be an instrument of much good in proper hands. To have from competent persons a succinct description of a new machine, an interesting process in an extensive manufactory, is a very great advantage both to those possessing a general interest in the arts, and also to practical men.

That there are disadvantages growing out of the abuse of this method of reporting, cannot be denied; and when it degenerates into puffiing the article under notice, and abusing all rival inventions, it becomes worse than useless. In the respectability of the committees of the Franklin Institute we have, however, a guarantee against anything of this sort; and the cautious tone of many of these papers indicates the conscienciousness with which the duty has been executed.

Unless in the hands of men of acknowledged judgment, we would deprecate the extension of the practice.

REPORT ON A PLAN FOR CONSTRUCTING RAILROADS, INVENTED BY MR. JAMES HERRON, OF MARYLAND, CIVIL ENGINEER.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Plan for constructing Railroads, invented by Mr. James Herron, of Maryland, Report—

That they have examined with much care and interest the drawings and model submitted by the inventor, and have had the advantage of this gentleman's personal explanations.

It appears to us that Mr. Herron has fully understood and appreciated the evils inseparably connected with those plans of railway superstructure, so much in use here, as well as in Europe, in which the rails are supported upon isolated blocks of stone, or sleepers of timber. In a climate like that of our northern and middle States, it is out of the question for us to encounter the expenditure which would be necessary in order to obviate the influence of frost. Even our best constructed roads are upheaved by its power, and where the supports of the rails are in the least degree unequal in their character, either in consequence of different dimensions, different depths of foundation, or different capacities in the sub-soil for imbibing water, the result is a succession of irregular elevations, depressions and lateral displacements, which are destructive alike to rails, cars, and engines, and productive of a jarring and lurching motion extremely disagreeable to passengers, and by no means free from danger. When the rails are supported on cross ties of timber resting upon mud-sills of plank, (which is also a common form of superstructure in America,) a much better form of road is obtained, though still far from perfect. The irregularities caused by unequal settlements are less numerous and less sudden, but there is still nothing to prevent one mud-sill from rising above another from the action of frost, where the ends of two come in contact. The sleepers may be, and no doubt are, often elevated entirely from the sills, and are also laterally displaced, giving a slightly serpentine form to the rails, which enhances the flanch friction materially. But even if all these evils be avoided, there is still a radical defect common both to this and the former plan, which is thus adverted to in a pamphlet written on this subject by John Reynolds, Esq., in 1837.—"The chief obstacle to durability which pertains to the plan of supports at intervals, whether they be blocks or sleepers, is the

alternation of *flexible spaces* and *rigid points*, which (even if the supports maintain an exact level) produces in carriages moving rapidly over them a series of concussions, as the wheels successively impinge on the rigid or supported parts of the rails. Also, however small may be the deflexion of the rail between its points of support, those points become fulcra, on which it acts as a lever, to raise or shake the supports next beyond them. When the supports have assumed irregular heights, (which is the usual case,) not only are the above evils greatly aggravated, but the rail acts on every depressed support as a spring-beam, tending to jerk it up, or loosen its fastenings."

In addition to the above, we may add, what is perhaps sufficiently obvious, viz., that the weight of the iron rails may be diminished proportionably with the distance between the points of support; and consequently, the minimum quantity of iron will be required, when the bearings are continuous.

The difficulties above alluded to are not merely theoretical. Every engineer who has had charge of the repairs of a finished railroad will vouch for their practical existence, although much discrepancy of opinion exists concerning the most appropriate remedies.

Mr. Herron's object appears to have been, to devise a plan in which all the parts forming the structure shall be fully and adequately supported; while at the same time they shall be so connected together, that no portion will be liable to independent displacement, either laterally or vertically. He has proposed several modifications, all of which he thinks may be applicable in particular situations. Those which the committee consider decidedly preferable, both from simplicity and efficiency, are designated on his drawings, as Nos. 1 and 4. In both of these, he uses a continuous line of timbers supporting each rail throughout, which are joined at the points of contact by a new scarph, peculiarly well adapted to the purpose, and strengthened materially by the manner in which the iron rails (which may be either T or bridge form) are attached to the longitudinal timbers. The whole is supported and stiffened by a system of diagonal cross planks, which have a triple use, as they afford a considerable breadth of bearing, act both as ties and braces to prevent lateral displacement, and being loaded by ballast, will counteract any tendency which the bearers might otherwise have to become warped by changes of moisture and temperature. Sand or gravel is to be rammed under the longitudinal timbers, so as to give them a firm and equable foundation throughout, and the whole roadway, when finished, is to be filled with the same materials, as high as the base of the iron rails.

The wrought iron chairs proposed by Mr. Herron for the joints of the rails, are of a form new to this Committee, and if they can be manufactured by machinery, (which, if good iron be used, appears probable,) will possess advantages over most of those now employed, as they will clasp the rails, without the intervention of wedges or screw-bolts, with sufficient firmness to prevent any deviation at the joints, yet not so closely as to hinder them from expanding longitudinally by changes in temperature. The rails are to be fastened permanently at their centres to the longitudinal timbers, so as to cause the expansion to take place equally in both directions, thus reducing the spaces necessary between the ends of the rails to a minimum.

The Committee do not think it necessary to enter into a minute description of the proposed plans, which could not be made fully intelligible without accurate drawings; nor do they wish to be understood as fully approving of all the parts, some of which appear to be attended with practical difficulties, though not of an insurmountable character. The principles

aimed at in the design have their fullest sanction; and they would gladly witness an experiment carried out upon a working scale, with timber kyanised, or otherwise prepared so as to be secure from decay.

Of course there are many points of importance embodied in the general scheme, which have been previously suggested by other engineers, who have at various times adopted similar contrivances. Other details are certainly original, and the whole combination evinces a degree of judgment and ingenuity which we hope will not pass unrewarded.

By order of the Committee.

July 9, 1840. WILLIAM HAMILTOE, Actuary.

REPORT ON THE BORING MILL, CONSTRUCTED BY MESSRS. MERRICK AND TOWNE.

The Committee appointed to examine the abovementioned Mill Report—

That the visit to the establishment of Messrs. Merrick & Towne, known as Southwark Foundry, for the purpose of examining their Boring Mill, afforded an opportunity to learn many interesting particulars, with a brief statement of which it may be useful to preface their description of the machine under consideration. Southwark Foundry is situated on the Prime Street Railroad, between Fourth and Fifth streets. The buildings occupy three sides of a plot 200 by 370 feet, and consist of a machine shop 160 by 40 feet, three stories high; a smith shop of the same ground area, one story high; a Foundry 180 by 50 feet, and a boiler shop 145 by 45 feet. The ground floor of the machine shop, with the exception of a portion at the front end, used as an office, is occupied by the Boring and Planing machines and heavy slide Lathes, one of which will turn a piece of work 4 feet diameter and 31 feet long. Upon the second floor are the lighter lathes, vice-benches, drilling machines, and small planing machine. In this room, at the time of the visit of the Committee, were to be seen various specimens of finished work, which fully sustain the good reputation of Philadelphia in this branch of manufacture. The third floor is used as the pattern makers' shop and pattern loft. Some of the patterns in course of construction for the frame of the engine of the New Jersey Frigate hereafter referred to, would seem, from their immense size, to be designed to form a large and highly ornamented building rather than parts of a movable machine. At the southern end of the machine shop is a steam engine of 15 horse power, which drives the machinery of this building and the adjoining smith shop. The latter contains 18 forges, the blast for which is derived from a fan driven by the engine. The heavier forges are executed under a small vertical trip-hammer, which is capable of faggoting a bar 6 inches square. This must prove of great advantage both as a labor-saving machine and as a means of obtaining greater perfection of the weldings. Some samples of forgings were shown which evince a high degree of skill in this important art.

In the Foundry much was seen worthy of approval. The machinery and apparatus do not appear to be more extensive or various than are seen in many other establishments, but the magnitude of the castings is much superior, and their perfect finish and soundness fully equal to any which have come under notice of the Committee. The permanent apparatus comprises three 8 ton cranes, two ovens for drying moulds, one 8 by 24 feet, the other 12 by 32, and two cupola furnaces, respectively 39 and 42 inches diameter, with a fan blast driven by an 8 horse engine. These cupolas are capable of melting iron for a casting of 16 tons. The heaviest piece of casting which has yet been made is a bed-plate for the U. S. Frigate's engines, which these gentlemen are constructing. For this casting, which

weighs about 14 tons, 36,000 lbs. of metal were melted in 2 hours and 40 minutes; the metal being drawn off into shanks as fast as it came down.

The plate has just been cleared from the mould, and displays in its broad proportions a most beautiful specimen of casting, presenting a surface of more than 200 square feet without blemish.

The steam cylinders for the same engines, weighing 8 tons nett each, were melted by the larger cupola above, in about the same time. The most rapid melting in this cupola was 9000 lbs. in one hour.

The boiler shop is enlivened with the din of hammers employed in making the boilers for the Frigate's engines, four in number, made of copper 14 feet 6 inches long, 14 feet wide, and 12 feet high, with double return flues, weighing, when finished, 200,000 lbs.

The engines for the U. S. Frigate, to which allusion has been made, are now in a state of considerable forwardness, and constitute an object of much interest to any one desiring the success of American manufactures. They are of the general form known as English Marine Engines--the cylinders being vertical, with two lever beams, one on each side, working on pedestals rising from the bed-plate, and connected with the cross-head over the cylinder and with the connecting rod, by side links.

The principal dimensions are, diameter of cylinders 75 inches, length of stroke 7 feet, bed-plate 29 feet 2 inches, by 7 feet 4 inches, with channels cast on—Main shaft, wrought iron, 17 inches diameter, 25 feet 8 inches long—Paddle wheels entirely of iron, 29 feet 8 inches diameter and 10 feet bucket. The work upon them was commenced in January, 1840, and is expected to be completed in the spring of 1841.

The large Boring Mill which was the special object of the visit to Southwark Foundry, appears to be of entirely novel construction, and especially adapted to work of great magnitude, such as is found in the large engines now building. The boring shaft is vertical, and the cylinder to be bored stands upright on the bed or face-plate, and revolves around the bar—the latter being stationary. The face-plate is keyed on to the upper end of a vertical shaft 8 feet long, stepped into a brass bearing, and confined by a collar directly beneath the plate; the collar being secured by heavy timber-framing, bolted to a massive brick foundation. A pinion geared to the main shaft of the steam engine gives motion to the face-plate by working into teeth on its periphery. The boring-bar is 14 inches in diameter; it is inserted into a recess in the centre of the face-plate, and secured at the upper end by a cast iron plate on the second floor of the building. Directly over this, on the third floor, is a hoisting machine for raising the bar and placing work on the mill.

The boring-head, on which the cutters are fixed, is keyed to a movable sleeve which traverses up and down the boring-bar upon two feathers, working in grooves on its opposite sides. The traversing motion on the sleeve and head is derived from a long screw which passes freely down the hollow axis of the boring-bar; and the head of the screw is a cross-head, connected by two stirrups to the sleeve. The nut of the screw swivels on the head of the boring-bar, and receives motion from a train of gearing and tangent screw: the rate of traverse motion is varied by changing the gearing of the nut.

The cylinder to be bored is screwed at the lower end to the face-plate, and at the upper end to a cast iron cross which works around a collet, fitted to the boring-bar, with slots for the passage of the stirrups which sustain the boring-head: this collet is movable up and down the bar, to suit the length of the cylinder.

By this arrangement the cylinder is firmly fixed at both ends of the bar

which carries the cutters, and cannot possibly get out of centre, nor be subject to any inaccuracy except what may arise from the springing of the boring-bar between the bearings at the ends of the cylinder, which is not likely to be an appreciable quantity in a cast iron bar 14 inches diameter. By substituting a cast iron rest in place of the boring-bar, for which provision is made, the mill is converted into a horizontal face-plate lathe, capable of turning a flanch 11½ feet in diameter. It will bore a cylinder of 96 inches diameter and 14 feet length. The work appears to be executed with much greater rapidity than is usual upon the horizontal mill—the cylinders for the Frigate, one of which was in the mill at the time of examination, having been completed in eight days each.

This machine must be esteemed of great importance in the construction of large machinery, both as a means of expediting the work and of insuring greater accuracy of finish. It has the advantage, in common with other vertical boring mills, of avoiding the imperfection of form arising from boring a large cylinder while lying on its side, such a cylinder being oval in its section when taken out of the mill and placed upright.

Possessing, therefore, as it does in the opinion of the Committee, both the requisites of novelty and usefulness, it is deemed a proper subject for the Scott's Legacy premium, an award of which is accordingly recommended.

By order of the Committee.

July 17, 1840. WILLIAM HAMILTON, Actuary.

LARGE SHIPMENTS—BUSINESS.—We learn that Messrs. Baldwin, Vail and Hufty have shipped from their extensive locomotive manufactory on Broad-street, within the last ten weeks, for various railroads in this country, two hundred and thirty tons of machinery, and six locomotive engines. They have lately received large orders for locomotives from this country and Europe, which, in connection with their orders for the manufacture of machinery of all kinds, speaks well for at least this branch of productive business.

We lately took a ramble through this extensive establishment, in company with a large manufacturer from another city, who was desirous of witnessing the use of Anthracite coal in forges, first successfully introduced, we believe, by Mr. Baldwin, but now in use at other large manufacturing establishments in this city. It works to a charm—is more economical in point of time and expense—those accustomed to it can take a better heat from it than from that in common use in forges—and what is more, when it becomes generally adopted, as we have little doubt that it will in the large manufactories throughout the United States, it will afford our own Pennsylvania a new source and a more ample field for deriving advantage from one of her most important natural agents of wealth, the produce of her coal mines. The casual observer seldom gives due consideration to the importance of unpretending improvements which are calculated gradually to accomplish very great and beneficial results, and such we consider this improvement.

In passing through the locomotive room, we observed some ten or a dozen engines "on the stocks," in various stages of forwardness, and though, perhaps, their progress in measuring distances, may not have been so rapid as it is expected it will be when they are placed on the road nnder full steam, there certainly seemed to be every facility for rendering their progress towards completion rapid. Our attention in this room was particularly attached to the splendid locomotive engine of the largest class, manufactured for the Emperor of Austria.

This piece of mechanism was ordered by Argnet Belmont, Esq., of New York, (agent for the Rothschilds,) for Emperor Ferdinand's north road, from Vienna to Lemberg, Austria. It differs in many points from those heretofore made at Baldwin's, (with the exception of the first, the "Old Iron Sides" still running on the Philadelphia and Germantown railroad,) in having the driving wheel in front of the fire box, and in having the eccentrics on the outside of the driving wheels. The fire chamber is of heavy copper, and many other parts are totally different from any other ever made. Two thirds of the weight of the engine is thrown upon the driving wheels. It is intended exclusively for heavy freight, and in comparing it with other engines of the same manufacture, whose performance is known from actual trial, it is estimated as capable of drawing from 380 to 420 tons upon an up grade of 7 feet per mile, at the rate of 12 miles per hour.

Some of the first engineers of our country, who have seen it, pronounce it the most powerful machine they have ever examined, and calculated, from its make and its power, to do an immense amount of service.

The manufacturers of Philadelphia, we believe, first started the locomotive engine building in this country, and it is, we think, readily conceded that they have not only thus far continued, but are likely to continue *first.—Public Ledger.*

PATENT GRANTED TO HENRY GRIFFITHS, FOR IMPROVEMENTS IN THE *Process of producing Prints or Impressions from Steel, Copper, or other Plates.*

These improvements in the process of producing prints or impressions from steel, copper, and other plates, have for their object the production of imitations of drawings, by several successive operations of printing different colors or tints upon paper or other suitable material, each successive impression being so carefully placed as to register with perfect accuracy and fit the previous impression, in order that, when the several successive impressions have been so taken upon one sheet, tablet, or surface of paper, or other material, the whole shall produce the effect of a drawing or picture delineated in its various tints or colors with a camel's hair or other pencil.

In performing this process, it is necessary first to provide a series of three, four, or more plates of copper or steel, as many in number as may be required to produce the different gradations of tints or of colors in the drawing to be imitated upon; these plates must be produced severally by the ordinary process of etching, stippling, aqua-tinting, or mezzotinto, or other suitable modes of engraving the selected parts or portions of the drawing which are to be represented by the particular tint or color printed from each individual plate.

When the several plates have been thus engraven, there must be lines or registering points marked upon all the plates accurately corresponding, in order that the first impression upon the paper may exactly register with the parts of the subject upon the successive plates.

The patentee has accompanied his specification with a series of prints, taken in the several stages of the operation, which it must be obvious we are unable to give examples of; and proceeds to state, in reference to the production of such subjects, the manner of proceeding:—

Supposing, he says, that I am about to print a flower in colors in imitation of a drawing,—I produce upon a plate, by some of the modes of engraving above alluded to, the form of the pale yellow part of the flower, which I then print upon the paper; I next produce a plate, having only that part of the flower engraven on it which is to represent the central

bright tint and the green stalk which I print upon the former impression. A third plate is then provided, having the forms of the shadows only; this is to be printed upon the two former. And, lastly, I produce a plate on which is engraven the deep purple tint of the flower, and having printed the last upon the three preceding impressions, I hereby complete the picture of the flower.

Again, supposing that the subject of the drawing to be imitated is a landscape,—I engrave a plate with the forms only of the gray tints, representing hills and sky, and parts of the foreground, and having printed this, produce the imperfect or first stage of the picture; a second plate is then provided, having only the forms of the yellow tints of the drawing, which is to be printed on the previous impression, and which will thus give to the picture the second stage of advancement; a third plate is then to be employed, having only the shades of the brown color and broad shadows of the picture, which being printed upon the two preceding impressions, gives a resemblance of the landscape drawing in a further advanced stage. Lastly, I provide a plate, having the stronger or more powerful parts of the picture engraven on it, and having printed this upon the three previous impressions, produce a finished copy of the drawing, which I desired to imitate.

The patentee further remarks, that he does not always print with oil colors, as some of the tints, designed to imitate water colors, would lose much of their brilliancy and delicacy if mixed with oil; he therefore sometimes employs moist water colors for printing; but, wherever brilliancy and purity are essential, he prefers to use the color in a dry powdered state.

The process of printing with oil color is so well known as to render any description of it unnecessary. That of printing from moist water colors has also been of late in use; but, if not generally known, it is merely necessary to observe, that the parts of the plate to be printed by moist water colors, are covered by a small dabber, and the smooth surface of the plate wiped clean by a damp rag.

In printing with dry colors, I first grind the color with pure water or spirits of wine, and, when dry, reduce it to a very finely-powdered state; I then apply the powdered or dry color to the parts of the plate required by means of a camel's-hair pencil, and carefully wipe off all the superfluous color by the hand, or by a soft leather. The plate is then put into the press, and the damp paper laid upon it, and after the dry color impression has been given to the paper, by passing the plate under the rollers, the successive impressions should be taken while the paper remains damp, excepting in cases where great force of color is required, which may be promoted by drying the paper between each stage.

THE ARCHIMEDES SCREW PROPELLER STEAM SHIP.

This important experimental vessel, of which we have recently heard so much, and which may yet be the forerunner of a revolution in steam navigation, made her appearance at the Broomielaw, on the forenoon of Saturday last. She left Liverpool on Thursday morning, and reached Douglas, in the Isle of Man, a distance of at least 70 miles, in 7 hours and a half, beating the "Mona's Isle" steam packet, full two hours in this passage. The Archimedes left Douglas on Friday morning, at a quarter past 9, A. M. and without losing a sail, by the assistance of the screw alone, reached Greenock at half past 12 the same night, though during the latter part of the voyage, from Ailsa Craig, the wind blew a strong breeze directly ahead. The distance form Douglas to Greenock is not less than 135 miles, which was performed as already stated, in 15¼ hours.

At a quarter past 9 on Saturday morning, the Archimides left Greenock for Glasgow, which she reached 11 A. M. As the vessel passed the various ship yards and steamers in the Clyde, her appearance was greeted by the same round of welcome cheering, which may be said to have echoed from port to port in her circumnavigation of the kingdom. Mr. Smith, the inventor of this application of the Archimedean screw, has attended the vessel in all her trips, and he is accompanied by Captain Chappell, R. N., who superintends the trials, and has been sent down specially by the Lords Commissioners of the Admiralty to report thereon. Of the courtesy of these gentlemen, and their readiness to grant every information regarding the workings of the steam-screw, we can speak in high terms.

The appearance of the Archimedes in the Clyde is an event of no ordinary importance, considering that it was upon these waters that the genius of Henry Bell, as applied to steam navigation, first developed itself, and that ever since our river has worthily maintained its station as the nursing mother of the art. Steam navigation, however, despite its mighty results, is yet only in its infancy; and in this quarter the trial trips of the Archimedes will be regarded with much interest. Indeed, it is scarcely a proper term to speak of trial trips, for Capt. Chappell states that the experiment has been neither more or less than a triumphal voyage from one end of the kingdom to the other. From the accounts which have been given from time to time, and recently in the Liverpool papers, most of our readers must be aware that the application of the "Archimedean screw" for the propulsion of vessels, was first tried by Mr. Francis P. Smith, the present patentee, about four years ago, on a boat 32 feet in length, and about six tons burthen. The screw was worked by a two horse engine, and such was the success of the fisrt experiment on this small scale, that the present vessel was finally projected and completed.

The Archimedes is rigged as a smart three masted schooner, with her masts raking. She is of a beautiful model, and having no paddle boxes, she has the appearance of a pleasure yacht, the flue being comparatively slender. The following are her dimensions:

Length over all,	125	feet
" between perpendiculars,	107	"
Extreme breadth,	$26\frac{1}{2}$	"
Depth of hold,	13	"
Draft of water (average)	10	"
Capacity,	240	tons
Power of engines,	80	horse.

The mode of propulsion is by, it might be said, a portion only of the Archimedean screw. When the vessel was first tried, a full turn of that species of screws (like a patent cork-screw, on a central straight spindle) was employed. The inventor afterwards, for the sake of compactness, introduced the double-threaded screw of half a turn to each thread, as more applicable to this vessel, although he rather prefers the other. This is of iron, and is fixed on the run of the vessel, in the dead wood in front of the stern post, and works transversely with the keel, radiating the water in every direction.—the diameter of the screw, (which is on the principle of the skull,) is 5 feet 9 inches, and its length 5 feet. It would almost appear impossible, that so small a portion of machinery could propel a vessel of such length, but the hold it takes of the water, and the velocity with which it turns, gives it great advantages. It is quite under the surface, and is therefore invisible by spectators either on board or on shore. It is worked by a spindle, forming its axle, running fore and aft, and is acquired by spur wheels and pinions. Each revolution of the larger wheel, turned

by the cranks of the engines, gives, by the multiplied power, five and one-third revolutions of the screw, and the operation of the propeller does not appear to interfere with the steering, which is managed with the facility of a small boat. The shafts of the engine work, fore and aft,—the cranks working transversely, so as to communicate the power directly by cog wheels to the screw. The larger wheel is toothed or cogged with horn beam (timber.) The vessel has given origin to "The Ship Propeller Company."—*Glasgow Herald.*

Large Casting.—We had the pleasure of witnessing, yesterday afternoon, at the foundry of Messrs. Merrick & Towne, the casting of one of the bed-plates of the engines to be placed in the United States Steam Frigate, now building at the Navy Yard. About *thirty-four thousand pounds* of iron were melted for this casting; the plate itself will weigh about *twenty-seven thousand pounds*, or thirteen and a half tons! The pouring furnished a fine spectacle; the time occupied in filling the mould was 1 minute 35 seconds. The bed-plate is 29 feet $2\frac{1}{2}$ inches long, 7 feet 4 inches wide, and $2\frac{1}{4}$ inches thick. The channel from the condenser to the air-pump, and two strong ribs, 23 inches deep, running the whole length of the plate, from parts of the same casting. The operation, which could not fail to be watched with anxiety by all concerned, was conducted with perfect order, and, so far as yet appears, with entire success.—*Phil. Inq.*

American Iron.—A writer in the National Gazette estimates the present consumption of iron in this country at three hundred thousand tons, and the average annual expenditure of each member of the community therefor, at two dollars sixty-five cents. The present selling price of bar iron is about one hundred dollars per ton, and it is asserted that it can be produced in the anthracite coal region for less than the amount of expenses and duty upon that which is imported. He supposes that the reduction of prices that must take place whenever the new works shall become capable of supplying the demand, will tend to increase greatly the amount per head, because of the substitution of iron for numerous purposes for which wood is now used, and because of the increased facility of supplying demands of every description that may arise; but admitting that the average annual expenditure of each person shall continue the same, and that the reduction in the price of iron shall be only twenty-five per cent., he estimates that there will be required in 1850 not less than 550,000 tons to supply the demand of a population that will then amount to from twenty-three to twenty five millions. The quantity required for that of 1860, then amounting to about thirty millions, will be nearly a million of tons, requiring not less than three millions of tons or iron ore, and six millions of tons of coal for its conversion into the various forms in which it is to be used, from the water pipe and stove plate to the pen knife. The production of Great Britain has risen, in twenty years, from 400,000 to a million and a half, and it is difficult to see any reason why that of the United States may not increase as rapidly. If these calculations be verrified by time, those who have invested their means in the coal and iron lands of Pennsylvania, and in the improvements leading thereto, will have little cause to regret it. In England, acres of coal land sell for hundreds of pounds, and we see little reason to doubt that such will speedily be the case here, as our population will speedily equal that of Great Britain and Ireland, and will double itself again in a little more than twenty years, and with every increase in the number of consumers. there must be an increase in the value of the land which yields the commodity that is to be consumed.—*U. S. Gazette.*

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 7, Vol. V. New Series. | OCTOBER 1, 1840. | Whole No. 367. Vol. XI.

WOODEN PAVEMENTS.

The history of this method of paving in wood is short and full of interest. Since the introduction of this practice we have carefully noticed every experiment of importance and have not done so without coming to certain conclusions of a practical bearing upon future trials.

In the first place, we believe it is pretty generally known that the method of paving in wood had its origin in Russia. The most approved mode of proceeding is to fasten together by wooden pins, hexagonal blocks of wood placed with the fibres in a vertical direction. From all that we can learn, the practice in this or a similar form has considerable antiquity, but from the high price of timber and the disadvantages attendant upon the earlier and more clumsy modes of construction, no one ever appears to have entertained the idea of introducing wooden pavements into western Europe, or even into the United States, until within the last six or seven years.

Somewhere about the latter part of 1833 or the commencement of 1834, a Russian gentleman, as we are informed, suggested the propriety of making some experiments in wooden paving to our city authorities. We greatly regret that we cannot ascertain the name of this public spirited individual who, without any emolument to himself, kindly volunteered all the information necessary for commencing the experiment. The specifications were prepared by the street commissioner, Mr. George B. Smith, who also gave his attention during the construction and thus secured a fair trial.

The spot selected for the experiment was in Broadway a few yards south of Chamber-street, and one about as well adapted for a severe test as any to be found in New York or elsewhere. When the old pavement was removed a densely compacted mass of sand and gravel, caused by years of enormous travel, was found, which required the pick and crow bar to remove it. The excavation was continued to the depth of 18 inches or two feet, which left the ordinary gravel and sand of our city exposed. Upon

this, three different foundations were laid for wooden blocks. In one place an ordinary pavement of round stones was laid; in another broken flag stones about four inches thick, were used, and in the third, broken stones were laid somewhat after the fashion of a McAdam, road one foot deep. These three foundations were so arranged as to give one unbroken surface one foot beneath the intended level of the street.

The blocks used were hexagonal prisms one foot long, and cut from a cylinder 9 inches in diameter; they were of hemlock, seasoned, but without any preparation by Kyanizing or any similar process. They were fitted into their places as closely as possible and wedged tightly between a curb on the two sides. Over the pavement thus neatly and accurately finished, hot tar was poured and over this, before it cooled, gravel was sprinkled.

The smooth and beautiful appearance of this pavement attracted general attention, while the change to the passengers in omnibuses, from the dreadful jolting to the easy and rapid passage over the wood, and back again to the jolt, never failed to elicit a wish that all Broadway was paved in a similar manner. Inquiries began to pour in from all directions, as to the mode of construction, and it was found necessary to keep on hand in the office of the street commissioner, copies of the description. In this way the experiment was soon got up in Philadelphia, Charlestown, Toronto, and in fact, nearly all our large cities and in Canada.

About 18 months after the pavement was laid, one or two blocks were found to be slightly depressed. On examination they proved to be affected with dry rot, and from the appearance of the tar on their surface, as compared with that on the sound ones, the impression was derived that this rot had commenced *previous* to their being laid.

The pavement has now been used *six years* in one of the most frequented parts of our city, and is yet, not only good, but better than any other in the city, except those of the same kind. No difference can even now be detected between the portions having different foundations, and this we attribute to the manner of wedging the whole breadth of the street, which, in a great measure, obviated the necessity for any other foundation. It is greatly to be regretted that a part was not laid directly upon the sand and also that some preservative process was not used. In that case we should have had six years experience more than we now have.

Since 1834, several trials have been made, and within the last year or two, satisfied of the excellence of the plan, a number of pieces have been laid by individuals of different neighborhoods to the amount of one mile or more. Some of the earlier of these trials were made with square or rectangular prisims, and in some the blocks were laid upon plank as a foundation.

The mode at present most extensively adopted consists in the use of blocks not more than six or eight inches deep and 12 to 18 in diameter, and these are laid directly upon the sand and gravel constituting the foundation of our city.

The chief, and in fact, the only valid objection to the general introduction of wooden pavements, is the greater cost than for common stone pavements, but in estimating this we must not only take into consideration the prime cost, but also the durability of the wood. In this view of the case we consider it to be mistaken economy either to do the work hastily or to omit some preservative process. Decidedly the best foundation is good even gravel or sand, and this has also the advantage of being cheapest. Whatever form of block or of foundation is employed, the greatest care should be used in fitting them into perfect contact, by which means the entrance of water and of decomposible matter, is nearly prevented. Some means of preserving the wood should always be adopted, for there is no doubt that the ordinary period of decay, may, by such means, be almost indefinitely protracted.

The use of hot tar, as in the first experiment, is a simple and useful, although superficial remedy. Kyanising is too costly, but there are other methods quite as effectual and much cheaper.

Of the superior comfort and cheapness of this mods of paving in great thoroughfares, there is no longer any doubt. In the first trial in Broadway, the wooden pavement has remained untouched, except where opened, rather for examination than otherwise. Its cost for repairs has therefore been nearly nothing, while the common stone pavement immediately adjoining has been extensively repaired several times and parts of it, if we mistake not, relaid. It is always less muddy and dries sooner than any other part of the street, and in all other respects is equally superior. But we are told that in retired streets, a stone pavement ought to last twenty years, whereas a wooden pavement will not endure half that time without decay. To be sure, under such circumstances stone *ought* to last twenty years—but does it, and as long as it lasts what is it? As to the limit of the durability of wood, we are inclined to doubt of its accuracy.

After all, the great bar is the prejudice against any thing new, which in this case operates to a greater degree than most are willing to admit. The subject appears to have become quite notorious in England and rival patents have been taken out, even for the angle and inclination of the grain of the wood from a perpendicular.

Besides ordinary streets, there are many other localities peculiarly appropriate to the use of wood. On account of its lightness, it has been preferred as a roadway for suspension bridges. Its exemption from noise and dust, while advantageous every where, is particularly so in the vicinity of churches, court houses, schools, hospitals, dwellings, and where delicate articles are sold. Its peculiar surface renders it an admirable substitute for flag stones, particularly where horses are obliged to cross, as in these situations it forms an equal if not superior footway, and does not cause the horses to slip and stumble as do flags. This quality has also recommended it as a paving where horses are used on railroads, particularly in cities, either when turning short curves or ascending steep grades. The facility with

which rails can be laid on this kind of foundation is another reason for using it more frequently, and in certain situations we are not certain that it would not be the best mode of laying rails. The opportunity for introducing this modern comfort and luxury of all who go through cities in their own or others vehicles, are so numerous as to ensure its general adoption. But meanwhile we must caution all interested in the matter from taking alarm at the speedy decay which must shortly overtake all these pavements which have been laid in a hasty or careless manner.

Another Triumph of Steam.—The steam packet Acadia, has performed her last trip in 231 hours (9 days 15 hours) from raising her anchor at Halifax, to droping it in Liverpool harbor.

To the Editors of the American Railroad Journal and Mechanics' Magazine.

If you think that the following communication on the subject of lattice bridges would be useful to your readers, you are at liberty to insert it in your Journal.

Among the great variety of bridge plans that have from time to time been presented to the American public, none have received a more flattering reception than the lattice arrangement of Mr. Town; its beautiful simplicity, light appearance, and especially its economy, have secured for it the favor of many of our most eminent engineers and builders, as is evident from the extent to which it has been adopted on works of the greatest magnitude and importance.

On ordinary roads, and on railways not subjected to very heavy transportations, this plan of superstructure, when well constructed, has been found to possess almost every desideratum, but experience has fully proved that unless strengthened by additional arch braces or arches, the capacity of the structure is limited to light loads and spans of small extent.

The public works of Pennsylvania furnish abundant proof of the truth of this assertion, and several railways might be enumerated on which the lattice bridges have from necessity been strengthened by props from the ground by arches, or by braces added when the insufficiency of the structure was found to require it.

These defects are producing a change in opinion hostile to the whole plan, and it is much to be regreted that instead of attempting such modifications and improvements as would remedy existing defects and retain its advantages, other plans are introduced at an expense frequently more than double that of an efficient lattice structure.

Improvements of this kind have been attempted, and are now offered to the profession; a description of them will follow after a brief examination of the apparent defects of the ordinary lattice, and of the general principles on which the alleged improvements are founded.

One of the first defects apparent in many lattice bridges is the warped condition of the side trusses. The cause which produces this effect cannot, perhaps, be better explained than by comparing them to a narrow and

deep board placed edgewise on two supporters, and loaded with a heavy weight; so long as a sufficient lateral support is furnished the strength may be found sufficient, but when the lateral support is removed the board twists and falls. A lattice truss is composed of thin plank, and its construction in every respect such as to render this illustration appropriate. Perhaps the action referred to could be prevented by bolting the cross ties to the chords in addition to the usual plan of notching, and by introducing a complete system of transverse diagonal bracing, but the mode recommended in the improved plan is, it is believed, much more simple, effectual, and economical.

A second defect is found in the inclined position of the tie. All bridge trusses, whatever may be their particular construction, are composed of three series of timbers, which may be considered as the indispensible elements: these are ties or uprights, braces, and straight or curved longitudinial pieces, known under the name of chords, arches, caps, ties, &c. In every plan except the lattice, the ties are either vertical or perpendicular, or nearly so, to the chords or arches, and as the force transmitted by any brace is naturally resolved into two components—one in the direction of the chord, the other perpendicular to it; this latter force could be best resisted by a tie, the direction of which was also perpendicular.

Experience has proved that the ends of the ties in lattice bridges have a great tendency to split, which can be accounted for from the circumstance that their inclined position subjects them to an angular motion, and consequently a cross strain upon the pins whenever the bridge settles. The short ties and braces at the extremities, furnishing but an insecure support, render those points which sustain the greatest weight weaker than all others; this defect is removed by extending the truss over the edge of the abutments a distance equal to its height, the effect of which is to provide a remedy at the expense of economy, by the introduction of from 15 to 30 feet of additional truss, requiring a corresponding increase in the depths of the recesses and thickness of abutments.

It is believed that the truth of the following propositions forming the basis of some proposed improvement, and which are susceptible of easy demonstration, no one who has attentively observed the action of the parts in systems of bridge frames will be disposed to question.

1st. The forces of compression on the upper, and the extension on the lower chords of a straight bridge are equal, and increase from the ends to the centre where they attain a maximum.

2nd. The vertical weight on the ties and braces increases from the centre to the ends, and in straight bridges uniformly loaded, is double as great at the latter as at the former points.

As a consequence of these propositions it follows, that a bridge whose corresponding timbers in all its parts are of the same size is badly proportioned, that some parts must be unnecessarily strong or others too weak, and that a useless profusion of material must be allowed, or the structure will be insufficient.

If, for example, the forces acting on the chords increase constantly from the ends to the centre, the most scientific mode of compensation would be to increase proportionally the thickness of the chords, and to include the principle involved in the second proposition, the ties and braces should increase in an inverse order from the centre to the ends.

These methods, requiring a variation in the size of every timber, would of course be inconvenient and expensive, but as the principles are of great importance, such other arrangements should be adopted as will secure their advantages and at the same time possess sufficient simplicity for practice.

These desirable objects are attained by the introduction of arch braces, than which a more simple and efficacious mode of strengthening a bridge could not be adopted, as they not only serve to relieve the chords, but transmit directly to the abutments a great part of the weight that would otherwise be thrown upon the ties and braces

As all the bridges in common use are composed of the uniform timbers already described, it follows that arches or arch braces are, for the reasons assigned, essential to them all, and it is gratifying to perceive that eminent professional men have noticed their importance and that the introduction of them is becoming general.

It may be objected that the pressure of the arch braces would injure the abutment against which they are placed, in answer to which it may be remarked that a certain degree of pressure is very proper and necessary. The embankment behind an abutment exerts a very great force upon it, the tendency of which is to push it forward; if then a counter pressure can be produced by the thrust of arch braces or by wedging the lower chords, two important advantages are gained; the abutment is not only increased in strength, but the tension on the lower chords of the bridge is diminished to an amount equal to the degree of pressure thus produced.

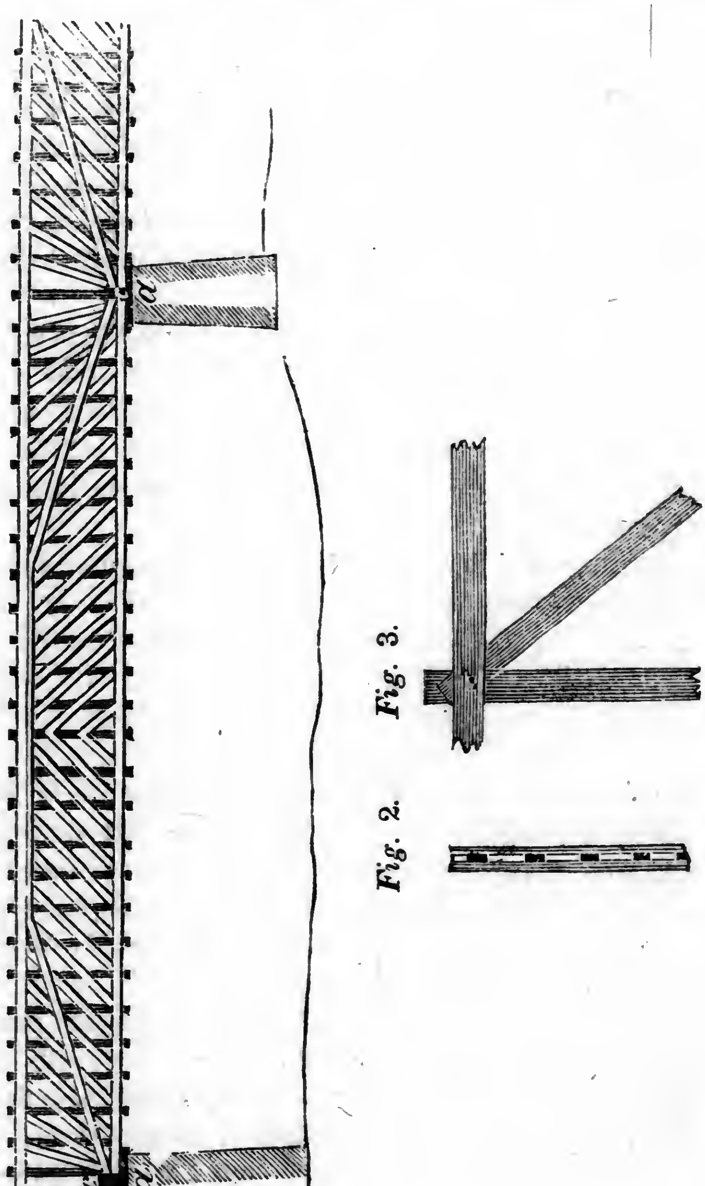
It is, however, proper to observe that when the situation of the embankment exposes it to the danger of being washee away from the back of an abutment, the pressure on its face should not be sufficient to destroy its equilibrium; if there is danger of this effect, additional horizontal ties may be introduced.

An essential condition in every good bridge is that it shall not only be sufficient to resist the greatest weight to which it can be subjected, but it must also be secure against the effects of variable loads; this is generally effected by the addition of counter braces, but the lattice truss possesses this peculiarity, that it is effectually counter braced without the addition of pieces designed as in Long's bridges, exclusively for this purpose; to prove this, insert the truss where it will be apparent that the braces become ties and the ties braces, possessing the same strength in both positions.

The foregoing remarks will enable the reader to understand the objects of the proposed improvements and the principles on which they are founded. (*See Figure.*)

1st. The braces, instead of being single as in the common lattice, are in

pairs, one in each side of the truss, between which a vertical tie passes, (fig. 2.) This arrangement increases the stiffness on the same principle that a hollow cylinder is more stiff than a solid one with the same quantity of material, and of the same length, and obviates the first defect of warping.



H. Haupt's Improved Lattice Bridges.

Fig. 1. *Fig. 3.* *Fig. 2.*

2nd. The tie is vertical, a position which is more natural, and in which it is more efficacious than when inclined.

3d. The end braces all rest on, and radiate from, the end of the abut-

ment, (*a*, fig. 1,) by which means a firm support is given to the structure, and the truss is not required of greater length than is sufficient to give the braces room.

4th. By inverting the truss it will be seen that it is effectually counter braced, the ties becoming braces and the braces inclined ties, capable of opposing a resistance on the principle of the inclined tie of the ordinary lattice, (fig. 3.)

It is readily admitted, that the strength in the inverted is less than in the erect position, but it must be remembered that when not subjected to more than its own weight, a bridge is always in equilibrium, that the peculiar action of the parts which renders counter bracing necessary results entirely from the variable load, and that therefore a combination of timbers to resist its effects, should not be as strong as that which sustain both the permanent and variable loads.

As it can be demonstrated that a very slight and imperceptible degree of compression at the pins of any lattice bridge, or at the shoulders of any brace bridge will allow the truss to settle to a considerable extent, it is essential that the holes should be bored very smooth similar to those made by a bit, and the pins should fit perfectly, in addition to which, they may be wedged at the ends.

The dimensions of the parts, which depend of course upon the size and character of the structure, may for ordinary cases be,

Braces, 2×10 in pairs.
Pins, 3×12
Arches or arch braces, 6×12.
Chords, 3×14 lapped.

Pins $2\frac{1}{4}$ in diameter, placed in line at right angles to the direction of the brace; 3 at the chords, and 2 at the intermediate intersections, (fig. 3.)

A wall plate should be placed behind and at a sufficient distance from the ends of the lower chords to allow of the insertion of wedges, (C. C.) by driving which the tension on the lower chords will be diminished by an amount equal to the pressure produced.

In conclusion it is proper to remark that the proposed plan is more economical than any in general use; the arrangement will be found even more simple than the ordinary lattice, and although these braces, in consequence of being in pairs, require a slight increase of timber, yet the diminished length of the ties and of the truss more than counter-balance this increase.

H. Haupt, C. E.
246 *Race-st., Philadelphia.*

RAILROADS V. CANALS AND RIVERS.

Extract from the report of of J. Edgar Thompson, chief engineer, to the directors of the Georgia railroad and banking company.

"*I can now state with confidence, that wherever the transportation is of a mixed character, such as agricultural products,* GENERAL MERCHAN-

DIZE, *and passengers sufficiently large, to justify the construction of a* GOOD ROAD, *railways will be found to be not only the most expeditious,* BUT THE CHEAPEST ARTIFICIAL MEDIUM OF CONVEYANCE AT PRESENT, KNOWN."

We give the foregoing extract from the report, and *experience* of a highly respectable engineer, in as much as we are gratified to find that light is beginning to develope itself, as to the capacity of railways, for general transportation.

The adaptation of steam to the improved locomotive, to draw immense loads over *iron ribed roads* at cheap rates, is destined to work as complete a change in our *inland forwarding business,* as the application of steam to propel boats against wind and currents, on rivers and the ocean. Steam and railroads will be the best bank to regulate our exchanges.

We may be sanguine in our view, and in advance of, and shock the prejudices of many, when we assert our conviction, that railways *are destined to supercede rivers and canals, in the transportation of valuable merchandize,* freight and passengers. The consumer will advocate them, and all must submit to the march of this better improvement of the day.

Our eastern neighbors, with their usual sagacity, must have arrived at this conclusion, or they would not have ventured on the expenditure of $6,500,000, to construct a railway from Boston to Albany to intercept our western trade. We would here renew the remark, made on a former occasion, that the three canals first constructed in New England, viz. the Middlesex, the Blackstone, and the Farmington, have been superceded by railways. The Camden and Amboy railroad, takes the income from the sluggish Delaware and Raritan Canal. The Philadelphia, Wilmington and Baltimore railroad is superceding the steamboats on the Delaware and the Chesepeake. It does not require a prophet to predict, that the Chesapeake and Ohio canal, will prove a perfect failure, compared with the Baltimore and Ohio railroad. We would desire to touch lightly on the losses of the stockholders in the Schuylkill canal, on even the prospect of the competition with the Philadelphia, Reading and Pottsville railroad. Suffice it to say, that the canal stock, which was $380 per $100, paid, prior to the commencement of the railroad, has fallen to $150 per $100, since it has been shown by actual experiment, that one locomotive has drawn 423 nett tons from Reading to Philadelphia, 54½ miles, in five hours, at the trifling cost of $57, all expenses included, for fuel, oil, engineers, and 4 men at the breaks. This sum also includes, $20 allowed for the use of the 101 cars on which this enormous load was conveyed.

☞With these facts before us, *should we not pause, and examine into our canal policy?* We ask the west to reflect on this subject, ere we are too deep in debt for railroads. J. E. B.

We have received the following reply to the communication of Mr. Aycrigg. We must remark that the article appears to have been rather

hastily written and contains expressions which the author himself would not perhaps wish to see in print a year hence,—a regard for all parties has therefore induced us to suppress all parts of the communication not bearing directly upon the question, as well as such epithets and expletives as courtesy would require to be omitted.

For the American Railroad Journal and Mechanics' Magazine.

Gentlemen—There would be no occasion for a rejoinder to such a communication as the last by Mr. B. Aycrigg, except from the numerous errors which it contains. These, however, they originate, demand of me at least the trouble of a brief notice.

If, then, he will turn to my first communication upon this subject, (R. R. J. vol. iv p. 241) published *before* Mr. B. A. wrote upon the subject, he will perceive why I was particularly called upon," etc. My reasons are contained in the very first sentence, and their substance is because those theories were *applied to explain the errors of de Pambour's formula*, the causes of which I had already, long previously assigned as well as expressed in magnitude, by general expressions, applicable to all cases of practice, and agreeing perfectly therewith. (R. R. J. vol.—) Is he answered? Did it require permission to do this?

I may, however, be allowed to ask, what Mr. B. A. has to *do with this part of the subject at all.* since the expression he quotes, obviously refers to *ideas promulgated by others*, some time previous to his having aught to do with the question—in his his own words, "Why does he suppose himself the object of attack when no one but himself has referred to him?"

Is he not as unfortunate in taking upon himself my remark about "an absurd estimate of the actual loss," since he does not venture to make *any estimate at all of the amount of the loss*, or to bring his theory to any practical conclusion. He is challenged to produce an expression of this, applicable to practice.

As to his expression of the amount of power lodged in the connecting rod at any particular point of the revolution, viz. p=P sec. d, and which was deemed a "profound absurdity." I would ask if, (taking the same case of a short rod for the sake of making the thing obvious) the secant of 90° is not *infinite?* and if when in that position, or near it, the force in the rod, viz. p would not "exceed P the *force upon the piston to an infinite degree?*" I would inquire if this is not manifestly absurd, and does not lead inevitably to the conclusion I have attributed to it, and if P. be put for but the power of an insect, for instance, whether P sec. d would not represent, in all strictness, an unlimited accumulation of force, and that too, *created*, simply by directing the rod more and more from the original diverting of the power?

Presuming interrogatories of this description to be entirely within the parliamentary rules, I would also inquire if at this very point, the force in the rod, instead of being very great and even unlimited, would not, agreeably to the principles of mechanics, be just nothing at all? No illustration can

make white black; but as to the illustration of a rafter, I would ask him if there is really no distinction in things? If the force of gravity, always acting vertically through the centre of gravity of the rafter or voussoir of an arch, would cause a thrust in the length of the rafter, at all analogous to that of a motive force acting *upon its end at* the point of support? And whether that motive force could possibly cause any more than equal thrust along the rafter, *even when* its direction coincided; and whether it must not be proportionately *less*, along the rafter in proportion as the *angle* its direction makes with the rafter is *increased*, till, when at right angles to it, the thrust along the rafter becomes zero, instead of the infinite one the expression implies. Is it not clear then that, as this *assumption* is the basis of all Mr. B. A. has said or done, that his whole superstructure necessarily falls with it? And will it not be time enough to disprove his details when he shall have established a foundation for them to rest upon? And can not he perceive in this too, why I simply adduced the proportion V : v : : sin c : R without further comment, or 'tilt' upon minor *points d' appui*, than to call attention to it, "as a matter which would equally overthrow his whole fabric." And has not its fallacy *since been exhibited* and by one too, whom he says, "has always thought with himself?"

Furthermore, I would ask him, if a train of cars, for instance, were to be *pushed* up an inclined plane by a power acting horizontally, a greater power would not be required in proportion to the inclinations of the plane, to force up the same train? or, in other words, whether if the power should remain constant like that upon the piston, the load would not have to be reduced? Not certainly that the load might be increased as the plane 'becomes steeper!' Is not this a perfect analogy—this uniform horizontal power representing that of the piston and the proportion of it effective up or along the plane, the effect it is capable of producing in that direction. Instead of the usual plan of railroads, if this theory of Mr. B. A. were true, *perpendicular roads* must entirely supercede them.

Again, I would inquire if, because I showed that that portion of the resistance to locomotion upon railroads which was usually designated "friction," was, "indeed, a compound result, including within it the effect of the crank," there is any reason or fairness in assuming me to have said that "the friction of the crank itself is the only loss in effect from crank motion?" Is there any thing in my language inconsistent with the fact that the loss in effect from crank motion is at least, almost entirely caused by loss of leverage in transforming the motion out of its original direction into the circular one of the crank, by means of the necessary gearing suitable to the purpose? It is not true therefore that I have in any way "yielded the point in dispute, or granted that there is no loss from the crank except extra friction," nor that I have in any way compromised a position that I have taken.

Mr. B. A. is challenged to produce his "practical demonstration" of an

expression of the powers of locomotives, which after tabulating and "combining several operations," "still require upwards of 30 distinct calculations." By the way, I would here inquire, why he applies my remark of "mere assertion," etc. in any way in connection with this expression? since the clause to which it *did refer*, was quoted entire and specifically.

Mr. B. A. insinuates that every argument I have used is untenable. Alas! for having been compelled in self-defence, to demolish a glass house! But is this the philosophy of "Newton." But no matter, I must rest satisfied that *they*, at *least*, do *agree* with, *and explain perfectly the results of practice*, and that I regard as a far higher commendation than even an agreement with any absurd and groundless opinions whatever. For my part I can see no difference between a mathematician and an astrologer, when the former deals only in signs without meaning or as representatives of things existing only in the imagination. The symbols of Newton represented real things, and he reasoned with them accordingly.

Wm. McC. Cushman, C. E.

Albany, Sept. 7.

DEPOTS AND GROUND FOR RAILWAYS.

Few railroad companies, on the commencement of their works, are aware of the extent of ground required for the accommodation and cover of their locomotive engines, for their cars, work shops, wood, station houses, etc. The consequence is, in the outset, the directors secure but partial accommodations, and afterwards they have to pay extravagant prices when their power by the charter to take land for the purposes of the road, (by appraisement,) is exhausted by non user. They are then completely at the tender mercies of individuals, who are generally as heartless as the corporation they have to deal with, and any advantages that can be taken of a "soulless company," is considered fair, although the construction of the road, is the main value given to their property.

We are led to these remarks from reading the first and last report of the directors of the Camden and Amboy railroad, giving an account of the requisite number of buildings and the square area, of ground they occupy for the same. It takes six pages of the report to give a list of the several buildings requisite to operate a road that is only 92 miles in length, with a freighting business in its infancy; in fact, they have but 17 engines, 71 passenger, and 64 freight cars, good and bad. To cover, preserve and keep in repair, this small equipment, the necessary buildings, with wood. sheds, etc., number 133, without including water stations, we find that the area of square feet occupied by the buildings, exceeds 230,000 square feet, or above five acres of ground. The *centre depot*, at Bordentown, contains 10½ acres. The number of acres occupied at the terminations of the road at Camden and at Amboy, is not stated. It is safe to estimate that upwards of 40 acres for depots are in actual use for the railway, mainly for a passenger business. If we recollect, the directors of the Baltimore and

Ohio railroad company, secured 15 acres in Baltimore at the commencement of their road—an extent of ground then considered ample, and even extravagant, by many of the stockholders. They had hardly got their road in partial operation, for the freighting business, when they were obliged to purchase five acres, at additional cost. We should be gratified to learn the number of acres occupied in the Schuylkill, Broad-street and other parts of Philadelphia, by those connected with the Columbia, the Reading, and the Baltimore railroads. If we are correctly informed, several entire squares are occupied in Broad-street, by the railroad forwarders connected with the three railroads leading from Philadelphia, to Reading and Pottsville, to Columbia, and to Wilmington and Baltimore.

The item of *real estate* and for *land damages!!!* on the Camden and Amboy railroad, is $371,769, or equal to $4041 per mile, for *right of way*, depots, and necessary grounds. This ratio, for a double track, is much within the cost of several eastern and other railways. We have not the report of the Stonington railroad to refer to; we believe it was some $6500 per mile. On the Long Island railroad they paid on the average, including the Jamaica railroad, at the rate of $7000 per mile, with but partial accommodations for depots. The Utica and Schenectady railroad Co. paid $5000 per mile, this ratio included the purchase of the Mohawk turnpike. The Syracuse and Auburn, paid $3000 per mile., or $375 per acre for land not worth $35 The New Haven and Hartford paid, near $7000, where there was a perfect choice of route, the land would have been given. if the error of premature location had not taken place. The Hudson and Berkshire cost $2000. The Western railroad Co. of Massachusetts, over the mountains and rocks of Berkshire, have paid at the average rate of $1700 per mile, or above $200 per acre. The general average width of railroads is 4 rods or about eight acres to the mile. From Tappan, over the hills towards Goshen, it is understood that the New York and Erie railroad Co. have allowed the proprietors, on an average, $2000 per mile, exclusive of depot, for land not worth one tenth this ratio.

We are led to present this subject for consideration, with the remark, that no prudent company should commence their work until they have secured the land on which to construct their road, so far as it can be done by compromise, particularly when there is a choice of routes, to provoke competition for the favor of the location.

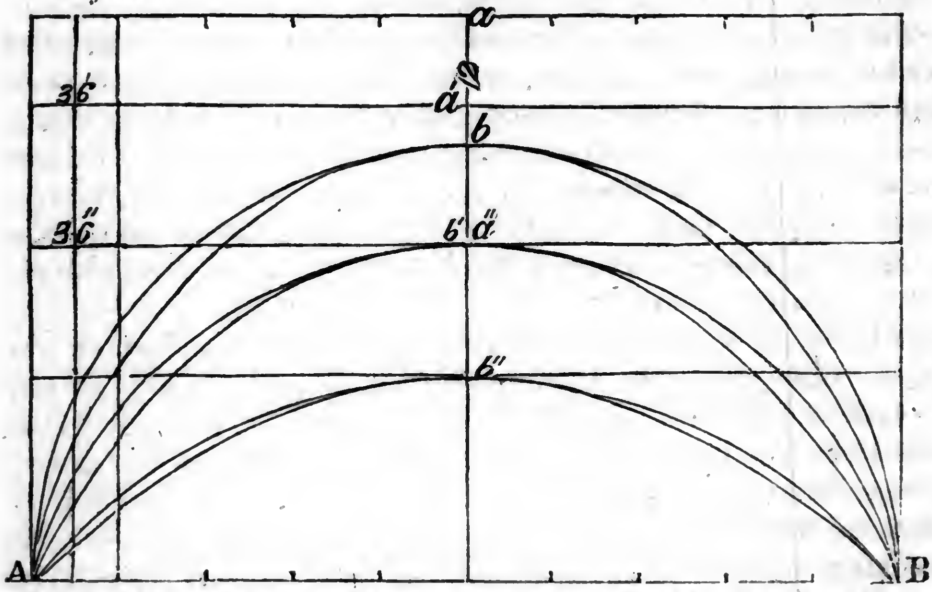
It would be highly useful if the different railroad companies, who have completed railways, and got them in operation, would furnish the Railroad Journal, for record, the amount of ground they have appropriated for their several roads, to wit: for depots—for the width of the road bed—the general cost per acre, or per mile,—the circumstances under which the ground was obtained—if by compromise—purchase—or by legal appraisement—if before or after the work was commenced, with general information on this interesting subject.

We desire to call attention to this part of railroad construction, as we be-

lieve there cannot be a railroad located in any direction without benefiting the land owners on and near its line; yet when a road is definitively located and the requisite ground not obtained, for the road bed, and for depots, relying on promises, it is then suddenly discovered by the land holder, that the railroad is a great damage to him, and he must be paid an extravagant price, or he will delay the work and contractors, so as to produce an item of damage to the company and compell them to compromise, at extravagant rates.

J. E. B.

ARCH OF EQUILIBRATION.



I have had the curiosity to ascertain the elements of three different arches of equilibration, and the same are represented by the accompanying diagram. They are all of the same span and extrade however, and differ only in elevation. The extrade is 12 feet above the crown, and level upon the top; the span is 20 feet. A b B is a semicircle, and within it is the arch of equilibration; and at 36 the distance to the curve of this arch is 42 feet, while to the semicircle it is only 35 feet, so that the last mentioned arch is loaded with only 5 in that place where it ought to be loaded with 6; and one in six you will admit, I presume, is no small proportion in any case.

Again.—Place one point of the compass below C and sweep the circular arch A b′ B so that C b′ will be 32 feet and within this last mentioned arch draw the one A b′ B of equilibration, and from 36′ to its curve will be about 27 feet, while to the circular arch of the same elevation the distance will be only about 32½, making a difference of about one in nine; that is, the circular arch is loaded at the point in question with only 8 when it ought to be loaded with 9.

Again.—Place one foot of the dividers further down and sweep the circular arch A b″ B with in elevation C b″ of 20 feet, and within this draw

the arch A b″ B of equilibration, and you will find the distance from 36″ to this last mentioned curve to be 29, while to the circular one of the same elevation, it will be only $37\frac{1}{2}$, so that the circular arch will be loaded at the point in question with 16 in this case, when it ought to be loaded with 17.

Again.—Upon this common base A B=80 draw an ellipse whose semi-conjugate is 20 feet; and at the point in question its curve will rise above the circular arch A b″ B; so that when the arch of equilibration is loaded there with 5, this elliptic one will be loaded with only 4; and about the same may be said of the cycloid. From this it appears that for the extrade here supposed the elliptic arch would require 20 per cent more weight upon its hances than it would have; the semicircle about 17, the arch whose chord is 80 and versed sine 32, about 11, and the arch whose chord is 80 and versed sine 20, about 6 per cent, so that the less the number of degrees which the circular arch contains, the nearer it approaches the one of equilibration.

Hutton seems to have spoken without due reflection when he said the elliptic or cycloidal arch was better than the circular one. It may be so in some cases but not so here.

DEFINITION OF THE SCIENCES.

Knowledge consists in understanding the relations which things bear to each other; and the word *thing* as used in the English language is as general as any word can be in any language. The word *relation* also, is very general and implies a resemblance. There are many points of resemblance, or many relations betwixt one man and another, though it is difficult to point out any one betwixt a pound of water and the diameter of the sun; and when we say we perceive *no* relation in such a case we know what is to be known respecting it, and it should not be here forgotten that it is quite as important, many times, to know that a thing does not exist as it is to know that one does so. In knowledge, and the same may be said of nature, there are three grand departments, *mathematics*, *physics* and *ethics*, and in mathematics there are three sub departments; *number*, *quantity*, and *magnitude*, and in each of these, our whole business essentially is, to *notate*, *add*, and *subtract*; and the relations here sought are those of *number*, *form*, and *size*.

The science of *number*, which is the subject of arithmetic, *calculates* that of *quantity*, which is the subject of algebra including the calcule, *compares*, and that of *magnitude*, which is called geometry, and might be more properly denominated megometry *measures*. In this latter case we always have, or imagine, a diagram to represent some definite object or form; but in abstract quantity the subject of algebra, the idea of form is not included

Physics, treats of *matter* as we find it including all the laws by which it is governed; for matter without some inherent law or property is no matter at all, and still, to define it to our own satisfaction, we find to be no easy task. It is this that we shall say, the different parts and kinds of which

affects each other; or it is that which affects our senses; and we have two kinds of it. Of the one, the particles tend towards each other, and are consequently said to be ponderable; of the other they repel each other, and are therefore said to be *imponderable*; and generally the latter is found to have an affinity for the former, and seems to be the cause of all its motion.

In *physics* there are three grand departments: *mechanics*, *chemistry* and *planetology*, and it is not the quack doctor, but one who is versed in physics who is the proper physician.

Mechanics treats of the modifications and dispositions of matter, and consists of three grand departments—*dynamics*, *design* and *handicraft*, and the latter is only the executable part of it.

Design embraces that portion of mechanics which depends much upon taste, and its object is to invent and to plan out what is to be done. Such a plan is called projection, and is *perspective isometric* or *isometricoperspection*; and either of these may be—1st. *Oblique*, when the spectator is supposed to be fixed in position, and viewing every point but one of the object in an oblique manner, and 2d. *Direct* or orthographic, when the eye is supposed to be directly in front of every point at which it is looking. Under this latter head of *direct perspective*, comes all maps, charts, and profiles, and also the representations which are commonly made of the polar regions of the earth. Under the *oblique perspective*, we have not only common perspective, but the *spheric oblique* or the stereographic; the same being that by which spherical surfaces are generally represented. The eye is here supposed to be at some point in the equatoral circle.

Dynamics treats of the powers of matter, and as the latter exhibits three forms we have *stereodynamics, hydrodynamics and aerodynamics*, and in each of these we have *attraction*, *repulsion* and *cohesion*.

Chemistry treats of the affiinit;es which different substances have for each other; ,and in ascertaining these affinities, it is generally necessary to take into consideration the *weight*, *composition* and *texture* ofthe substances themselves; and thence we are naturally led to inquire their *use*, *location* and relative *quantity*; and it may be added that we have the chemistry of nature in *animals*, *vegetals*, and *minerals*; the chemistry of the *chemist* in his labratory, and the chemistry of the cook in the kitchen, for even bread is an homogenous or a chemical compound of flour, water and yeast. As to *planetology*, it must be remembered, that dynamics teaches us that every particle of ponderable matter, of whatever size, in the universe, which is neither constructively, as in case of the meteor, nor actually, in contact with some other one, must be in a globate form, and moving either in a plane orbit, or back and forth in various directions around some point, and rotating also upon one of its own axes, and it is the knowledge or description of these bodies, which dynamics thus finds and leaves whether in the form of suns, stars, proper planets, or comets, that we call planatology, and here we have *three* grand departments:—1st. their physical graphy or *planetography*. 2d. The *arrangement* which their matter assumes; and 3d.

Of which we expect never to know much, their *original* and *ultimate destination.*

Speaking of the sun, we should have *heliology*, and under it *heliography*, etc., of which we already know something. Of the moon we should have *selenology*, and under it *plenography*, etc., of which we also know a little. Of the earth we have *geology*, and under it *geography*, etc., of which we know considerable, and under the arrangement of matter here, we have *bionology*, *mineralogy* and *oryclotogy* or *endageology*, and *bionology*, we have *zoology*, *botany* and *byomycetology* , and the nature of biorick forms fall under the head of *oryeonology*.

Ethics treats of the laws by which any thing whatever is governed, and these laws consists of *self-preservation*, *security* and *aggrandizement*, and the manner in which they act is called *phrenology*. In all cases except that of man, they are said to be natural, while in his case they are said to be moral; and it must be remembered that one aggrandizes himself by good actions, and belitters himself by those that are bad.

ON THE STEAM ENGINE.

(Continued from page 181.)

The business of a civil engineer has been defined, "the useful application of the exact sciences to the common purposes of life." The successful fulfillment of his duties, then, depends on two distinct conditions:—

1. The engineer must understand the exact sciences relating to the business he undertakes.
2. The sciences to be applied must be exact.

Now, as the last of these conditions has never been attained on this subject, the former is impossible. Hence the obscurity of this branch of science, and the contradictory opinions thereon, frequently amounting to infatuation. As our object in these papers is to be truly and practically useful to society, our endeavors will extend to the substitution of plain facts and substantial truths for the uncertain theories and certain errors hitherto prevailing. Thus by clearing the mind from what is mistaken, removing obscurity by intelligible statements alone, we may hope to secure that desirable objeet—the speedy and universal improvement of the steam engine.

Hence, there arise two especial reasons for treating this subject much at length and very minutely; and these reasons must supply a sufficient excuse, if any be necessary, for our seeming prolixity.

The first and principal reason is derived from the immense and increasing importance of the subject to mankind. Its present certain and numerous imperfections are proved by its contradictions, and hence its probable improvement, from a full, careful and unprejudiced review of its theoretical and actual constitution, may be expected.

The second reason is derived from the consideration, that to be really useful, we must convince the most prejudiced of readers, and the most heterogeneous and opposite characters imaginable. The theoretical and non-practical or *learned* class, par excellence, including the writers at the head of this article, who expounding and misexpounding many things unheeded by practical men, confuse the latter, and thence assume infallibility; while the practical classes, whose opinions have been created and fortified by years of experience, have become equally prejudiced in favor of some peculiar and isolated practice, and as impatient of contradiction as theorists: it is thus improvement is hindered and errors perpetuated.

To correct or uproot these errors, to obtain increased and to extend real information, we must patiently compare the opposite theories together, and both, with reason. To obtain better results, let us compare the opposite practical opinions with each other, and all with experiment.

Provide a leaden boiler 4 or 5 inches diameter, and 12 inches deep, nearly filled with dilute sulphuric acid, diluted till it just boils at 320°; then take a stout barometer tube; seal one end, and bend 6 inches of the sealed end and graduating it into twelve equal parts, fill the graduated end with mercury, and also 1 inch of the longer end of the tube; then pass a drop of water through the mercury to the sealed end of the tube.

Now, suspending the tube at a convenient height, and inserting its lower end into the dilute acid by elevating the boiler, apply heat, so as to cause the acid to simmer, and maintain a constant temperature, when the drop of water, expanding into steam, will expel the mercury from the sealed end of the tube, and also all the water except a small portion thereof, which, converted into steam, remains in and occupies the graduated end of the tube, compressed by 7 inches mercury, and also by atmospheric pressure equal to thirty inches mercury. The steam then remaining in the tube is of just sufficient force or elasticity to balance 37 inches mercury, and in just sufficient volume to fill the graduated tube.

Connecting other barometer tubes to the longer end of the sealed tube, and adding successively such additional columns of mercury as may be each equal to 37 inches when measured from the lower compressed surface of steam, while the acid bath is maintained at a constant temperature, we shall find on adding one column of 37 inches, we double the pressure on the steam, and reduce its volume just one half; on adding another column, we treble the pressure and reduce the volume of steam to one third; on adding another column, we quadruple the pressure, and reduce the column of steam one fourth.

We shall find also, by removing the boiler for an instant to permit inspection of the graduated tube, that on removing or repeating these pressures, a constant and exact corresponding increase or decrease of the volume of steam is perceptible.

Hence, then, we experimentally ascertain within a heated cylinder, *the volume of steam to be proportional to the pressure*, and that the opposite opinions of Messrs. Renwick and Palmer are alike unfounded. Now, the condition of expanding steam in a heated steam engine cylinder, (which, steadily at work and amply supplied with steam, is necessarily as hot as the hottest or unexpanded steam therein,) must be fairly assumed to be correctly though minutely represented by the condition of the steam within the aforesaid graduated tube, maintained at a constant temperature; wherein it is evident no heat or power was latent or lost, or could be so, during the expansion of the steam from a small to a larger volume; but the steam, on the contrary, always retained its full and proper quantity of heat, and a power proportioned to its volume, exhibiting a gradually decreasing force consequent on expanding a definite quantity of elastic fluid into a larger space, but which expansion or enlargement is utterly inconsistent with any actual or observed loss of heat or of power; because, as we well know, the steam may be restored at will, by contraction into its former volume, heat and elasticity, by renewed compression alone, as shown in our experiment.

How idle, then, are the arguments and apprehensions that heat becomes latent, or that power is lost on the expansion of steam, which in an engine is merely a particular application—an advantageous and scientific expenditure of power! How unfounded, then, are the theories of the writers at the

head of these papers! How much plainer, simpler and better are facts than speculations, however ostentatious!

It has been determined by chemists, that the "bulk of all elastic fluids or gasses are ever inversely as the pressure to which they are subjected, while the temperature remains constant; and this property and condition of the gasses corresponds exactly with the condition of steam as detailed in our experiment; for, as we have previously shown, steam within a heated cylinder never becomes latent; it remains subject to the same laws, and has the same elastic force under pressure as the gasses—all which is apparent enough, and has been and can be easily proved by our experiment.

It really seems no easy task to decide whether the science of the non-practical classes most *promotes* or *retards* the general improvement of the steam engine, (in which so much more has been effected by the persevering, practical Cornish engineers, than by all others;) so many unfounded assumptions having been made by learned men, from which they always pretend to prove without doubt or contradiction (as in Mr. Palmer's case) that one of the most valuable properties of steam with which we are acquainted—its expansive force—is *valueless and useless.* For Mr. Palmer, basing his arguments upon *his* science, reiterates (ad nauseum) what the British engineers credit and sanction, and what every learned man expounds with woderful solemnity—that the joint sum of the latent or insensible heat in steam, and the sensible heat therein, is an invariable quantity; now, as we have incontesbtily proved there is *no heat latent in steam*, it necessarily follows, however sanctioned or solemnly propounded, that all deductions from these assumptions are visionary, deceitful, and infinitely worse than useless.

That heat in steam of every density is an invariable quantity, is as indubitably shown by our experiment as confirmed by those learned but mistaken opinions of its quality; but just as much as nature is more simple and correct in her arrangements than philosophers in their sophisms, so are the facts more simple, convincing and elegant, that the heat in steam of every density is ever active, and invariable in quantity, and the volume and temperature thereof ever exactly proportioned to its elasticity; and thus, by analysis, steam is proved to be a more simple elementary compound, and a more regular, powerful and valuable agent, than philosophers have contemplated in their misconceptions of its nature.

What singular and different results arise from the mistakes of practical engineers, or of theorists! Should the former omit any thing essential in his construction, or admit any thing unessetial therein, he must supply the one or remove the other before his machinery will act.

How different the conduct of the non-practical theorist! How tenacious of opinion once formed! How proudly does he disdain to add or diminish an iota from his solemn dictum! How incomprehensible (as Mr. Palmer has it) is any fact, however authentic or notorious, that contradicts the long cherished, and therefore unquestionable inspirations of theorists! For instance—what is more familiar, accredited, or appealed to by theorists, than the thermometer, (*anglice*, heat measure) and what can be more loose, trifling or erroneous than attaching such a name to such an instrument? Were it called an indicator of heat, as it only ought to have been, instead of a measurer of heat, unnumbered errors, arising from the mistaken notions of steam, incalculable losses, extreme miseries, and national disgraces, resulting from this misapprehension alone, would have been spared to society.

The distilling apparatus in our former paper is evidently a true and certain measure of heat, for as it invariably separates from steam of any

and of every density, the same exact quantity of heat from the same corresponding quantity of water, no possible doubt can be entertained of the correctness of its indications: hence, then, this distilling apparatus is truly entitled to the expressive and comprehensive term, "thermometer." Now, if it is so rightly entitled, by what name should the present mercurial instrument be distinguished? for by comparing its performance with its name, by testing it with the *true thermometer*, we find it the most unaccountably variable and inconstant instrument imaginable; for, compared with a true instrument, within the range of fifty atmospheres, its measure of the same quantity of heat is ever varying in the amazing disproportions of 1 to 180. How erroneous, then, this name! How deceitful and dangerous this application of the term to such an instrument—an instrument of perpetual reference in the most delicate and important experiments that science can devise!

This complicated and deceptive action of the mercurial thermometer evidently depends on the different rates of expansion by heat between mercury and glass. In Turner's Chemistry, it is stated that mercury and all fluids expand in volume with an increasing ratio at increasing temperatures; and that glass, having the same tendency to increase more in volume with increasing temperature, and having nearly the same increasing ratio as mercury between 32 and 212°, the correct action of the thermometer remains nearly unaffected thereby. How different this (if it be so) from the higher temperatures we have quoted, where the capacity of the glass bulb must either have increased faster than the volume of mercury in the ratio of 180 to 1, or both have been proportionally affected in some intermediate but equivalent degree!

As the physical cause for this great anomaly is unknown, it seems singular it has been hitherto so disregarded, as it is evidently a curious subject, well deserving the notice of any institution aspiring to the term scientific; we cannot refrain from commending it to the notice and attention of our friends of the Mechanics' Institute of New York, for elucidation.

Improper as is the name, and misleading as has been the nature of the mercurial thermometer, yet in skilful hands, with the aid of Ure's or of Dalton's tables of elasticities and temperatures of steam, it affords a ready means of ascertaining the internal state and power of a working engine, by applying it to the various parts thereof; and in this way may many matters now unknown or disputed, be quickly, quietly, and satisfactorily disposed of, or become plainly exhibited.

As one example of the utility of this ready mode of acquiring information, we will test by a thermometer the actual value of a recently patented improvement of the steam engine, of great celebrity and greater promise, being the invention of one of the leading members of the British society of civil engineers, who is at the head of one of the largest steam engine factories in Lonnon, where of course every facility may be supposed to exist for testing the value of any improvement previous to submitting it to public notice or animadversion.

Thus, the Messrs. Seaward propose heating the water in its passage from the hot well of the engine to the boiler 60°, by the steam in its exit from the cylinder to the condenser, expecting and promising a saving of no less than ¼th of the fuel thereby; and all this they propose effecting by causing the water to travel through thin copper tubes inclosed within the eduction pipes of the engine; now, the simple application of a thermometer to those pipes will in a few minutes show their temperature to be but little if any in excess of the temperature of the hot well, from which the water is fed to the boiler; and hence we see the water cannot be heated a single degree by this therefore useless contrivance, unless some improper, say wire-

drawn, interruption of the steam in its passage from the cylinder to the condenser be interposed, which would be so prejudicial to the power of the engine, that to suppose it to be practiced by any honest engineer is impossible.

How easily might all this have been fore-known, from the fact now so apparent, as every part of the eduction pipe is alike a part of the vacuum, so called; and as every part of this vacuum is alike occupied by and alike warmed by steam of a corresponding elasticity and temperature, so no part thereof can be hotter than another.

The same discovery was patented by another ingenious mechanic, Mr. Hase, of Saxthorpe, Norfolk, England, and applied to an engine for the Norwich flour company, forty years ago; and Mr. Hase promised the same advantages, and expected of course the same profit then as the Messrs. Seaward are now anticipating. Surely the lawyers who contrived, and so kindly, the dear English patent laws for the great encouragement of genius, as they have it, can alone discover that genius is certainly rewarded.

We have observed a thermometer attached to the eduction pipe of a Watt's pumping engine to stand at 90°, and not to differ a degree from the temperature of the hot well; and we have as often seen the same engine continue steadily at work for some time, with the safety valves of the boilers thrown open, and with the small greasing-cock in the cylinder-cover unclosed, and consequently admitting a constant, small current of air to enter the steam engine cylinder. Thus the engine was working with steam of considerably less elasticity than atmospheric (which elasticity might have been easily ascertained from the tables by the aid of the mercurial thermometer); hence the estimates of Professor Renwick, however he obtained them, are very erroneous, viz. that pumping engines, loaded as they are with 10 lbs. per inch, require a steam pressure of 17½ lbs. which we see they do not; and as the difference between the fact and the Professor's statement is so very considerable, this his calculation of the useful effect of low pressure steam is very much underrated, and only calculated to mislead in a matter of great import.

Again, the professor as extravagantly overrates the value of high steam as any of the earlier and wildest projectors, by stating (p. 22) "the general law of the expansive force of steam is that while the heat increases in an arithmetical ratio, the expansive energy increases in a geometrical progression." And at p. 23, gives an exact measure thereof, the tables of Dulong and Arago, calculated to fifty atmospheres. Our experiments have shown these imaginary laws of heat in steam to be vain dreams, and only innoxious now, because fully exposed.

Having published these tables, accompanied by such plain and unreserved statements as above, it could have been only expected they were intended by the professor as guides to practice; for if they were not so intended, they would most probably be, as they ever have been, very pernicious. But so far as we can discover, the professor does not mean any such thing; nor are we able to ascertain with any precision what he does mean, having left this essential matter quite undecided; and making very different assertions in different parts of his treatise, which assuredly is a strange way of treating a subject requiring mathematical accuracy and precision above all things.

What a contrast does the following quotation present to that just quoted from p. 22! At p. 162 he says:—"The density of steam increases nearly as fast as the pressure under which it is generated; did both increase in the same ratio there would be nothing gained by the use of high steam."

Although the professor is vastly nearer right in p. 162 than at p. 22, the

latter law absolutely contradicting the former law, yet our experiments prove him still incorrect and mistaken considerably, as the density of steam is always exactly proportioned to and increases fully as fast as the pressure; and therefore nothing is or can be gained by the use of high steam as such; which is amply though unintentionally certified by the professor.

We have seen that professor Renwick not only doubts, but completely contradicts himself on these very important and most essential matters. Not so Mr. Palmer, who states his opinions not only without doubt, but terms his every assertion, however astounding, an established law of nature. Some of these we quote in detail, lest it should appear incredible that they were ever admitted into a scientific journal. At p. 182, he says:—"I care not whether the steam applied as motive power be what is termed atmospheric, or high pressure; whether it be worked expansively, or otherwise; whether condensed or blown into the atmosphere; whether the engine be of the denomination technically termed single, double, or atmospheric; or, in fact, whether the steam be applied to any other apparatus human ingenuity can devise, even in the absence of all friction."

What quixotic conceit, what indistinct notions, what confused ideas these, for a sober, philosophical civil engineer!

Again, from the same page: "From the aforesaid data I will show that nature herself cannot produce a result (in the absence of all friction, as before premised) amounting to one half of what is stated to be the duty of some of the Cornish engines."

What a delicate appreciation of the credibility of the disinterested Cornish reporters; and what a happy and instructive comparison between the artificial performance of a steam engine and the unartificial efforts of nature!

Again, from page 183: "Having stated the maximum effect that nature is capable of accomplishing, 44,467,500 lbs. water raised one foot high with one bushel best Newcastle coals, and having shown the maximum effect that can be accomplished by the atmospheric steam generated by a bushel of coals my next object will be to demonstrate that high pressure steam, when applied expansively, cannot produce so great an effect as atmospheric steam."

Whoever reads the above quotations, that is capable by education and practice of forming a just opinion thereof, must perceive Mr. Palmer, however otherwise informed, is profoundly ignorant of the subject he has so hardily and so unluckily attempted. In proof of this our assertion, he says, he "cares not whether the steam is expanded or not." Now, as the expansion of steam, doubtless, greatly adds to its useful effect, as we will hereafter show, in crank engines, (Prof. Renwick has stated five times) it is evident to every one well informed on the subject that Mr. Palmer could not have understood the nature or value of the elastic force of steam, which property is in itself as simple and easy of comprehension as the power evolved during the unbending of the main-spring of a watch.

That any individual engineer could be found at this period, so apparently learned or even plausible, yet so really ignorant of his selected subject, would be incredible on any evidence but his own; or that such vague and confused ideas should be sanctioned by any society of practical men, or that such unfounded and dishonorable detractions from the Cornish engineers should be allowed by their countrymen and fellows, the London Society of Civil engineers, could never be credited, did they not appear in their own publication.

Let it then ever be remembered how much the successful industry of the Cornish men have added to the wealth of their nation, and how much their successful ingenuity has increased its engineering character, by showing

the greatest improvements of the steam engine, which the London engineers have neither had the sagacity to appreciate or imitate, the liberality to praise, or the prudence to avoid disparaging, while all other engineers behold them with unbounded admiration.

We shall satisfactorily conclude the present paper, and this portion of the subject, by another quotation from Mr. Palmer and the few and necessary observations thereon.

"If the statements given to the public by the Cornish engineers are correct, I dare not trust myself to call nature to account for the undue favoritism she confers upon our Cornish friends, by enabling them to obtain results in Cornwall that the London, Manchester and Birmingham engineers cannot approach; and I shall perhaps be excused from expressing my surprise that the question has not long ago been set at rest, by some one erecting in London or elsewhere an engine capable of raising 70,000,000 lbs. (I will not ask so great a favor as 120,000,000 lbs.) of water, one foot high, by the consumption of one bushel of coals. Let this only be done, and I shall be the first to hail the result as one of the greatest achievements of man over matter, and give the Cornish engineers that meed of praise they would so richly deserve for the benefits conferred on science, or upon the manufactures and commerce at large."

Now in a late number of the Engineer's Journal, it appears a Cornish pumping engine has been erected at the East London water works, that has lifted 72,000,000 lbs. of water a foot high, by the consumption of a bushel of coals, besides the friction of the engine and machinery. This would seem to show that there was very little cause for or reason in Mr. Palmer's exquisite work, in which he has exhibited nothing creditable to himself or to the institution of the civil engineers, or useful to mankind.

As we have endeavored, so we trust to have fully relieved him from all future trouble of making established laws for nature; and as his relief must thus be very considerable, we hope his gratitude will be proportional.—*American Repertory.*

SOUTHERN RAILROADS.

Mr. Chase,—I hand you herewith an extract from a very able article in the New York Review, for April, 1840, on "improvements by railroads and canals." The particular object I have is to show the preference given by the writer, to the great line improvement, of which the Georgia railroad forms a part. He copies and endorses the classification made by Monsieur Chevalier, of the public works of the United States, in these words:

"In the United States great public works must have for their objects

First. To bind the shores of the Atlantic with the country west of the Allegany; that is to say, to connect rivers, such as the Hudson, the Susquehannah, the Potomac, the James river, or bays, such as the Delaware or the Chesapeake, either with the Mississippi, or its tributary, the Ohio, or with the St. Lawrence, or the great lakes Erie and Onotario, whose waters are conveyed by the St. Lawrence into the sea.

Second. To establish communications between the valley of the Mississippi and that of the St. Lawrence, that is to say, between one of the great tributaries of the Mississippi, such as the Ohio, the Illinois, or the Wabash and lake Erie, or lake Michigan, which lakes of all those which have an outlet by the St. Lawrence, extend furthest south.

Third. To connect the north and south poles of the Union, New York and New Orleans.

Independently of these great systems of public works, which are in pro-

gress of construction, and even in part executed, there exist secondary groups of lines of transportation, having for objects either to facilitate the access to centres of consumption, or to open outlets to certain centres of production. The first of this class of cases embraces different works, canals or railroads, which leave the great cities as centres, and radiate in different directions around them. The second comprises such works as have been executed to bring into market different coal fields."

After speaking of the first and second classes of public works, as affording little or no inducements for the investment of private capital; indeed the writer goes so far to say that, "to individuals, such investments, to any great extent, would prove certain bankruptcy and ruin," he proceeds to say in reference to the third class:—

"There is no such uncertainty as to the third line of communication mentioned by Mr. Chevalier, that between New York and New Orleans. Connecting, as this does, the metropolis of the union with the great Atlantic cities of the northern and the capitals of the southern States, this line of communications has at the same time the advantages of forming the most direct line between the eastern and southern States, and of traversing a belt of country which presents for the execution of a line of railroads, peculiar facilities. The public has evinced its perception of the advantages of this great line of thoroughfare, by the large amount which has been contributed within the last six or eight years, almost entirely from individual resources, to its execution. The separate links which have been so far made, bid fair, even should it not be extended beyond its present terminus in the south, to be extremely profitable; but there is scarcely a doubt, that within six or eight years more the whole chain of communication will be completed to New Orleans, and that there will then be a travel and trade over every portion of it, beyond any present conception of its extent.

At the time of the publication of the sketch of Mr. Chevalier, detached links only in this chain of communication had been made as far as the Roanoke, in North Carolina. Within the two years which have since elapsed, the Philadelphia and Baltimore, the Richmond and Fredericksburg, and Richmond and Petersburg railroads, have been put in operation; and south of the Roanoke, lines of railroad have been completed to Wilmington in North Carolina, at the mouth of the Cape Fear, and to Raleigh, the capital of the State on the more direct route to Columbia and Augusta. Between Columbia and Branchville, on the line of railroad which connects Charleston and Augusta, a railroad is now in progress of construction, which it is understood, will be completed in the course of the present, or early the coming year, leaving only the distance between Raleigh and Columbia (about two hundred miles, but which is said to be of extremely easy execution,) to be constructed, to furnish a complete railroad communication between New York and Charleston and Augusta. Between Augusta and Montgomery, on the Alabama river, whence to New Orleans there is for about two thirds of the year an excellent steamboat communication, railroads now in progress of execution will probably be finished by the time the line north of Augusta is in readiness.

Great profits may undoubtedly be anticipated in every portion of this great chain of communication, when executed with tolerable judgment and under favorable charters. In another point of view, however it is much more interesting to us. No line of improvement which has been projected in America, and perhaps none which can ever be made, is so important in a political as well as a commercial aspect, as the one we have been contemplating. In the time of war, the government will be enabled by it, with a moderate standing army, to provide for the defence of its whole Atlantic

coast, an object not to be attained effectually without it by the whole force of the country. It will furnish in such a contingency, the means not only of transporting men and munitions of war, but in the event of the blockade of the coast, of exchanging the staples of the south and manufactures of the north and east. In the estimation of the patriot, devoted above all things to the preservation of the Union, this connexion, between what Mr. Chevalier terms *its two poles*, has yet a higher value. "When," he remarks, "New York shall be only six or eight days journey from New Orleans, not only for a rich class travelling in a privilege manner, but for every shop keeper and every workman, separation will no longer be possible. Great distances will have disappeared, and this Colosus, ten times vaster than France, will maintain its unity without effort.

It is among the many fortunate circumstances of our country, that its most essential line of improvement offers such strong inducements to its speedy execution, both in prospects of profit presented by it as an investment, and its other advantages. In other countries, the works essential to their defence and protection have been executed usually at great cost, and with heavy burdens on the subject. With us, the one which is to make us impregnable in war, and to unite us indissolubly in war and peace, is, at the same time, to add largely to the wealth of the nation, and of the shareholders of the companies co-operating in its execution."—*Southern Banner.*

NECKAR.

REPORT ON MR. L. PHELEGER'S SPARK ARRESTER.

The committee on science and the arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an apparatus for arresting sparks issuing from the flues of locomotive engines, invented by Mr. L. Pheleger, of Philadelphia, Penn., Report:—

That they have examined this apparatus, and witnessed its operation on some of the engines of the Philadelphia and Baltimore railroad, where it has been on trial for several weeks.

It consists of several parts, the arrangement of which will be described with as much detail as is essential to the object of this report. Around the smoke-pipe of the engine which is of the usual form and dimensions, is placed a case of sheet iron perforated with some thousands of small holes, resembling those of a fine nutmeg grater with the burr turned inwards. This case is sufficiently large to leave a space of two inches width between it and the smoke-pipe, and rises several inches above the top of the pipe; it is closed at the top by an inverted conical cap of thin cast iron, which is fixed on a hinge and furnished with a lever and rod, by which it may be raised out of the way when the fire is first kindled, for getting up steam. Outside of the perforated case just described is a second casting of sheet-iron, not perforated, but furnished with twelve out-let pipes about six inches diameter, six of which pass out at its base, and after two bends, or elbows, are again inserted at its top: the other six are similarly inserted at the top of the outer case, but have their lower insertion within about 12 or 15 inches of the top.

The annular chamber between the two cases, is open at the top for the ultimate escape of the smoke and vapour.

When the smoke and cinders are thrown up the smoke-pipe by the power of the exhaust, they strike against the conical cap which closes the top of the perforated case, and rebound into the annular space between it and the enclosed pipe, with great velocity. The smoke and other gasses from their small momentum, soon lose a part of their downward motion and are

forced out through the numerous perforations, which present an aggregate area of passage much greater than the section of the smoke-pipe, and thus give free vent to the gases. The cinders having a greater density are carried downward by the joint effect of their momentum and gravity, until they are beyond the effect of the exhaust, and are finally shaken by the motion of the engine into an iron receptacle connected with the annular space in which they have been deposited.

The smoke and steam, with some of the fine particles of dust, having passed through the perforated case, enter the annular chamber between the two cases, and are mostly carried to the bottom of this by the portion of their directive force which they retain. From this they escape by the six longer out-let pipes described as proceeding from the base of the chamber and are given out at the top of the chimney; the small sparks, if any escaped through the perforated case having been extinguished, or deposited in the circuitous course through which they must travel.

This circumstantial statement of the action of the apparatus is given, because at first view of it, not much confidence was placed in the probable result; but repeated trials having proved its complete efficiency, it was deemed worth while to examine minutely into the mode of its operation, and give a brief description of it in this report.

The trials in the presence of the committee were made under a variety of circumstances, well calculated to remove all uncertainty of the entire correctness of their observations. On the first occasion they travelled behind the engine from Elkton to Gray's Ferry, a distance of 45 miles, entirely after night. On the journey down to Elkton they were conveyed by an engine provided with a spark arrester of some other form, whose it was they did not learn, but it may suffice to say of it, that the route was enlivened after night-fall, by a copious shower of brilliant cinders, which were scattered many yards to the lee side of the road, notwithstanding a heavy rain which was falling at the time.

On returning with the apparatus which is the subject of report, they were agreeably surprised to find that while the engine was running with the fire door closed, not a single spark made its appearance. When the engine was standing, or when the fire-door was opened, a few sparks were seen to escape, but the number was so small as to be easily counted, and they were so light that they were extinguished, or burned out before passing half across she road. A subsequent trial was made in the presence of some members of the committee, when both engines, going and returning, were furnished with this apparatus, so as to give an opportunity of witnessing its effect by day and by night; the result on this occasion was equally satisfactory as on the former.

As the committee have had some experience of the operation of spark arresters, and have generally found, heretofore, that they were efficacious only in proportion as they impeded the fire draught, it was deemed important to inform themselves particularly on this point, in the present case. On enquiry of the engineers who are using the apparatus, they agreed in asserting that the engines made steam quite as well with it as without, and some of them supposed even better. The engines used on these trials were drawing their usual train on a full trip, and certainly made abundance of steam, blowing off during a considerable part of the trip; and an examination of the fire when the furnace door was opened, showed that the effect of the exhaust was not perceptibly diminished.

In conclusion, the committee feel entirely free to state their conviction, that the experiments witnessed by them were completely successful, and if farther trials made with heavy trains shall give similar results, and the ap-

paratus is not found to become impaired in its efficiency, by the choking up of the perforations, as has been the case with some others in which the perforated sheet has been used, they believe it will constitute the long-sought desideratum of an efficient machine which completely removes all danger and inconvenience from the chimney sparks, while it does not sensibly diminish the power of the engine.

By order of the committee.

William Hamilton, *Actuary.*

August, 13, 1840.

ADVANTAGES OF COMPRESSED PEAT. By Alexander S. Byrne.

The properties of peat have been long known to the scientific world, and it is matter of surprise that no attempt has been made at an extensive diffusion of the advantages which it possesses in a *compressed* state. These advantages are so important as to deserve and demand the greatest possible attention in every country where peat abounds. What is more interesting than to give employment to the industrious poor of any country? What so much so at this period as to provide constant and profitable employment for those of Ireland? Great and important as is the discovery to this country, it is so in a more especial degree to Ireland, whose bogs will be rendered as valuable as coal mines, holding out the pleasing hope that in time that unhappy country will become the seat of those arts of which cheap fuel may be said to be the parent. Such, however, would be an effect consequent upon the production and application of compressed peat.

To enumerate all the advantages of compressed peat would appear as one of the delusive hopes with which the present age has teemed: it will therefore be sufficient to explain such as are palpable, and which cannot with reason be doubted.

Peat (sometimes called turf,) consists of vegetable matter, chiefly of the moss family, partially decomposed by the action of water. The dense black turf, or lower stratum of peat bogs, is much contaminated with magnesia, sulpher, iron, earth, etc., while the upper stratum consists of almost pure vegetable matter. In its natural state it is loose, fibrous, porous and spongy, and contains generally from 30 to 80 per cent of water. The filaments are very strong and elastic; but when decomposed they yield readily to pressure, and break into disjointed pieces like small worms or threads.

From its extreme lightness, and impurity of the lower bed, turf is not generally employed as fuel, or as a useful article in arts and manufactures; but in countries where it abounds, and where coal is scarce, it is cut by the peasantry during the summer season, dried, stacked, and used for domestic purposes. There are many varieties; but in almost every region the top surface consists of pure vegetable fibre, undecomposed; and whether consolidated or not, can be beneficially employed for the production of dyes, pyroligenous acid, distillation, and many other purposes to which wood and vegetable substances are generally applied.

When compressed to the solidity of coal or wood, it can be successfully, beneficially and very profitably employed for the following purposes:

As *fuel;* for this use it is of inestimable value in steam navigation and railroad carriages, effecting in stowage alone a saving of at least one third.

For the production of gass; in which it gives birth to many improvements.

For *smelting ores;* particularly iron, copper, and lead.

For an *improved road;* superior to wood, stone or asphaltum.

For pavements, flooring, pannels, cabinet and ornamental work.

For the manufacture of *paper*, cements, pigments, *dyes, pyroligneous acid, etc.*

For lime burning, and many other similar purposes.

The cost of production, dependant of course upon localities, must still, on all occasions, be very small, from the facility with which it is worked; and looking at the price of coal, it is not too much to assume that in all districts where peat is found, it can be raised and compressed 50 per cent cheaper than any other fuel. These facts can be proved upon incontestible evidence, and exhibit one of the sources whence profits must accrue to those who are engaged in applying them.

A great obstacle in the compression of peat is the presence of water and the strength of the vegetable fibre, the resistance from which has been matter of surprise to all who have studied the subject. The superabundant moisture may be easily pressed out in almost any description of press; but this can only be continued to a given point; for when the interstices of the peat are closed up, the resisting force of the confined water and air is so great, and the possibility of their escape so effectually prevented, that the block of peat undergoing pressure becomes itself a hydraulic; and however much pressure may be afterwards applied, the confined water, aided by the strength and elasticity of the fibre, will react when the pressure is removed, and force the whole mass back again to the state when the superfluous moisture was removed. This is in fact the starting point; and those who have reached but so far in the art of compression have done very little for the removal of established difficulties.

To overcome these difficulties, many remedies might have been proposed. Mr. Charles Williams, of Dublin, proposes to break up the peat to a fine powder, until it assumes the consistance of *pap*. Thus by destroying the vegetable fibre and all resistance from that source, he presses this pulpy mass into a solid lump, either in perforated boxes or in hair cloths, as in the compression of linseed cake. I have seen some specimens of Mr. Williams's peat denser than oak, and have used coke prepared from this source with extraordinary advantage.

Lord Willoughby d'Eresby, Mr. R. C. Stewart, Dr. Geary, and several others, have successfully applied various presses, with escapes for the confined water from the centre of each block of turf undergoing pressure. Mr. White, of London, (an engineer) has succeeded in extracting a large proportion of water, and in producing an extraordinary hard peat by means of a vacuum. He covers a large perforated surface with peat, and by withdrawing the atmosphere from beneath, he forces a vacuum, extracts the water from within the turf, and obtains a very close substance for domestic and other uses. Prof. Maugham, the celebrated lecturer at the Polytechnic Institution in London is explaining this process, and applying it to many branches of manufactures with wonderful effect.

But the most simple and least expensive mode is to *evaporate* the water, and compress the peat *while warm*. By this means not only is the water dispelled, (being converted into steam) but the moisture of the inner threads is so completely rarefied, and the resisting force from the vegetable fibre so entirely destroyed, that compression to any degree of solidity becomes comparatively easy, beside which a principle of cohesion is imparted to the whole mass, which causes it to unite without any further disposition to return, as is the case before the vegetable fibre is destroyed. Upon the same principle, a *warm* blanket can be squeezed perfectly dry; a *cold* one cannot. In fact, it is a universal principle, that water in a state of steam is easily dispelled, and that bodies when warm and damp have a greater disposition to unite than in any other state.

I should therefore recommend this method in preference to any other for the compression of peat: As soon as it is cut from the bog, it should be spread upon a large table with a fire underneath, that the water may be evaporated; and while the vegetable fibr is still warm and moist, compressed in suitable presses into square blocks. The kind of press is of no consequence; but I have found a monkey or stamper press preferable, as it is very cheap, and can, from its construction, be easily removed from one spot to another.

Two men can cut and compress more than two tons per day, and the cost of necessary machinery would not exceed $100.

In the coking of compressed peat there is much for communication; and more particularly in its application to the manufacture of iron, gas, roads, etc., which will be fully explained in our next paper.

TO CHARLES WYE WILLIAMS, OF LIVERPOOL, IN THE COUNTY OF LAN*caster, gentleman, for his invention of certain improvements in the processes or mode of purifying or preparing turpentine, rosin, pitch, tar, and other bituminous matters, whereby the power of giving out light and heat is increased, either when distilled or burnt as fuel.*

This invention consists in a peculiar mode of rendering the several bituminous matters, as turpentine, rosin, pitch, tar, &c., more effective, when used for the purpose of giving out either heat or light, by bringing such bitumens into intimate contact with atmospheric air, in order that several of the gasses with which they are charged, and in particular the combination of ammoniacal gas, known to be injurious in the processes of burning for the production of light or heat. In order to afford the best information for carrying my said invention into effect, I give the following description of the process of means which I employ, namely:—I place the bitumen to be purified in a large pan, or vessel, over a fire,—and when raised to near the boiling point, I cause a second vessel, shaped and pierced with numerous holes, like a colander, to descend into the former; and when filled with the melted bitumen, to be raised suddenly a few feet, to allow the melted stuff to fall through in shower-like streams, by which, in the act of dripping down and returning to the first mentioned pan, the melted material comes into extended contact with the atmosphere; the result of which is, that a large portion of the ammonia, and its combinations, and other gases, with which such bitumens are charged, are expelled or drawn off by the atmosphere.

This filtering or mixing process, by which the bitumen and atmospheric air are so brought in contact, is to be kept going on, until the material has received the required extent of purification, and which operation may be carried on as long as desired.

This process of lifting the bitumen, and allowing it to fall through the colander or other shaped vessels, pierced full of holes, may be effected by mechanical means, or simply by hand utensils.

The temperature to which the bitumen must be brought, should be about the boiling point; but varying, of course, according to the kind of bitumen operated on, and which a little practice will soon point out.

While this process is going on, I cause a strong current of atmospheric air to pass across the falling portions, drops, or streams of the bitumen, by means of a fan or other well known mechanical means,—the object being to cause a larger admixture of air with the bitumen, in the act of falling or dripping down, and by which the ammoniacal and other gasses, which are very volatile, are passed off in great quantities.

I do not intend to confine myself to bringing such bitumens to any par-

ticular temperature, or to continue this filtering or mixing process for any particular length of time; but intend to avail myself of any extent or continuance of this operation, until the air has sufficiently acted on the bitumen, with which it is thus mechanically brought into contact.

And whereas, the process of purifying the various bitumens above described, has been practised by other persons, I make no claim to purifying such materials by any other means; but I do claim that mode of purifying the same, by agitation and mechanical admixture with atmospheric air, and for the purpose of exposing extended surfaces of the bitumen to contact with atmospheric air.

New York and Albany Railroad.—We regret to hear that no satisfactory steps are making in behalf of this great, and, to the city, important work. If any amount of stock has been taken of late, the fact has not come to our knowledge. We can hardly account for this apathy or this neglect, inasmuch as by night and by day, the workmen are pushing on with the Great Western Railroad, to connect Boston with Albany.

It seems to us that if a Railroad were established between this and Albany, on the latest improved plan, and of the best materials, such as are most of the railroads in England, that there could hardly be a doubt of a profitable result. An odinary Railroad, on which a Locomotive would average only 12 or 15 miles an hour, would hardly compete in summer with the Steamboats on the Hudson,—but a road on which the traveller could go his 40 miles per hour, reducing the distance from Albany and New-York to only four hours, would be a serious competition with the navigation of the Hudson even in summer, inasmnch as Albany could then be visited and returned from, in a single day-light, and with ease. It is very true, such a road would cost a great deal more than most of our roads per mile, but it is not a better one than there ought to be, under such circumstances, particularly between the capitol and its great commercial city.

We remark, by the way, that the most expensive railroads in England have now become most valuable investments, some of which are built with less of promise than this we have under contemplation. On twenty lines of road, from December to July last, comparing the quotations of stock in the share list, the increase in value amounts to the enormous sum of *eight millions Sterling*. "Thus," says the Railway Times the Great Western shares in that peried have risen 52*l*. per share, namely, from 10 discount to 42 premium, equal to 1,200,000 upon the 25,000 original shares. The Loudon and Birmingham shares have in like manner risen from 50 premiun to 99 premiun—equal to 1,225,000*l* upon the 25,000 original shares. The quarter shares have risen from 22 to 36 premium, equal to 200,000*l* and the new shares have risen 13*l*, equal to 405,950*l*—making altogether upon the shares a sum of 1,830,950*l*. The shares of the other lines in the following table are computed in the same manner.

Great Western	1,925,000*l*
London and Birmingham	1,830,950
Grand Junction	829 000
London and South Western	612,000
Eastern Counties	448,000
North Midland	420,000
London and Brighton	360,000
Manchester and Birmingham	180,000
London and Croydon	165,000
Great North of England	150,000
London and Blakwall	120,000

York and North Midland		102,000
Birmingham and Gloucester		95,000
Chester and Crewe		90,000
Bristol and Exeter		90,000
Cheltenham and Great Western		75,000
Birmingham and Derby		63,000
London and Greenwich		60,000
Total improvement in value,	$38,024,720	7,604,944*l.*

NEW RAILWAY LOCOMOTIVE; INVENTED AND CONSTRUCTED BY MR. WALTER HANCOCK, OF STRATFORD, ESSEX, AND NOW ON TRIAL ON THE EASLERN COUNTIES' RAILWAY.

One of the principle advantages of this locomotive is presented in the boiler, by which steam of greater power is generated with far greater certainty of continued supply, and more perfect safety, than by the boilers now in use, either in railway, marine, or stationary engines. This boiler is constructed of a number of distinct chambers, each chamber composed of several tubes. Each chamber, or rank of tubes, connects with two general cylinders or reservoirs—one at the bottom for the supply of water, and the other at the top for the reception and passage of steam. The communications from each chamber to the water, steam, pipes or reservoirs, have self-acting valves. When any leakage occurs, from wear, rents, or other causes, to any one chamber, the valves belonging to it close, and are kept to their seats by the pressure of water and steam contained in the neighboring sound chambers, and the boiler remains as effective as before, excepting that the surface of that one chamber, is thrown out of use, without stopping the engines, and perhaps it would not be observed by the engine driver until the end of the trip, when the pressure being reduced by withdrawing the fire, the valve would fall from its seat and point out the defective chamber by the discharge of water. In half an hour a new chamber could be attached in its stead. In the ordinary locomotive boiler, when any one of its tubes become defective, the whole is rendered inoperative by reason of the unchecked communication of all the parts with each other, and so it remains until the defective tube is repaired, replaced or plugged, which generally occupies three or four hours, and is attended besides with the inconvenience of stopping the train until another engine is procured from the next station.

By adopting the improved boiler, no such delay would occur, and the expense both in fuel and wages, of keeping a number of engines with their fires up ready to meet such casualties, would be avoided, as well as the risk when a train stops out of time, of having another train brought in collision with it, and the lives of passengers and attendants endangered.

The great heating surface obtained in a comparatively small space, is likewise a recommendation to this boiler. It is intended to attach a reciprocating set of fire bars to it, by which a clean floor of bars can be introduced without lowering the fire. The small weight of this boiler in comparison to its generating power, is another material point in its favor, for it leaves room for giving sufficient strength to all other parts, without exceeding the present total weight of a locomotive.

Having given a general description of the power—the engines and machinery come next under consideration.

The engines of the present locomotives are placed horizontally, and are thereby very much confined and difficult of access, but in this one they are

vertical, and therefore the whole of the machinery, pumps, etc., are open to view, can be readily oiled, and speedily detached for repairs; or any portion may be put right and secured while the engines are working.

The engines of this locomotive give motion to a separate crank shaft, and this communicates the progressive motion to the wheel axle by an endless chain, working over a pulley fixed on each, and which two pulleys may be either of equal or different diameters, so that advantage may be obtained either for speed or power whichever may be required. This arrangement not only allows the wheel axle to be straight instead of cranked, but it also possesses the advantages of a moderate accommodation or play, by which all sudden jerks or concussions of the machinery, etc., are avoided.

The friction is reduced to above one-half, from such large eccentricities, crank-bearings, etc. not being required, in consequence of the weight of the machinery, boiler, etc., being on straight instead of cranked axles.

This arrangement allows the work to be immediately thrown out, so that the engines will work the injection pumps, and get up the fire without working the driving wheels. By running locomotives about to effect these purposes, much of uneecessary wear and tear is incurred, besides running on the rails in the way of trains, etc. The present locomotive need not stir from the spot until the train is attached—the clutch then thrown in, it immediately starts upon its trip.—*Railway Times.*

AMERICAN ENTERPRISE.

We understand that the Emperor of Russia, by his agent, has closed a contract with Mr. NORRIS, of Philadelphia, for *two hundred locomotive engines*, forty of which are to be delivered each year, for which the Emperor is to pay $1,400,000. These engines are principally to run upon the great railroad, now in construction between St. Petersburg and Moscow.—We believe Mr. Norris had previously made a contract to furnish several engines to the Government of Austria, and our readers will recollect seeing it stated in the papers some time since, that the locomotive of Mr Norris, took a premium in England after a full and fair trial with many others.

This is another, and a most conclusive proof that the ingenuity, skill and enterprise of our countrymen, in a fair trial, is fully equal to that of any and every other people, and that whenever and wherever we come in competition with equal advantages, we shall come off victorious.

It is now the opinion of scientific men, who have looked into the matter, that there is no longer any doubt of the *complete success* of the experiment of manufacturing iron with anthracite coal, and if so, that *America must soon become the great iron market of the world*, as she will be able to furnish the article much cheaper than it can be obtained any where else. The subject of railroads is now being discussed throughout Europe. France has at least 1000 miles in contemplation, and Russia and Austria as many more; and even the government of the sublime Porte, is beginning to talk of a railroad from some of her outer ports of the kingdom to Constantinople. When we recollect that five years since, we were obliged to send to Europe for our locomotives, and that now we can manufacture them *cheaper and better*, both for ourselves and others, can we doubt that within ten years from this time, Pennsylvania will furnish to Russia, to France, and to Austria, not only her locomotives, but her *railroad iron.*

Thus then, the tide of trade will be completely turned, and instead of paying to Europe interest for money, to make our railroads and canals, we shall not only be able to cancel our State debt, but receive millions of Europe in return for the iron and coal of our mountains.—*Penn. paper.*

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 8, Vol. V. New Series.	OCTOBER 15, 1840.	Whole No. 368. Vol. XI.

RAILROAD FARES.

Much has been said upon this topic, and yet we conceive that not half enough has been done. It is true that it is impossible in a short time to judge of all the effects and their amount, where fares have been reduced, yet on a well established line, it requires no very great sagacity to predict the permanent effect, when the experiment of reduction has been continued for some months.

Several circumstances have recently drawn our attention to this branch of railroad tactics and we design to throw out those hints which have occurred to us, rather for the sake of drawing out further remark, than from any desire to present any regularly dijected treatise of our own. We do this the more readily as we know that the experiment of reduction of fares has been extensively tried and the communication of the results would be instructive in a high degree.

From a notice in a recent English paper we perceive that on the Liverpool and Manchester Rail Road, individuals of great wealth have been known to prefer the lowest price cars, even when the difference was inconsiderable. On one occasion it was testified that one of the wealthiest bankers of Liverpool was found in the lowest class of cars—mere boxes—unprovided with either seats or shelter—while not a single individual was in those of the highest class.

We recollect to have seen something of this kind, on one of our rail roads, where there were two classes of cars. Those of the second class were quite as good as any we even wish to ride in. It is true that those of the first class were better. Nearly all the passengers were found in the second class cars while but a fewer chose to ride in those which being a little better cost half a dollar more. Now in this case the intention was to separate the passengers and leave the cars of one class free from any unpleasant company. It turned out, however, that the company was equally well behaved and we have no doubt equally respectable in both classes—

and while the object sought was not attained—we learned that people in all classes of society prefer the cheapest mode of travel, even in the face of trifling inconvenience.

Proprietors of Rail roads and Steamboats seem to be well aware of the increased travel and income, due to a reduction of fare—and on many occasions avail themselves of this principle—but they do not seem to remember that the plan judiciously pursued, will if permanent, add to the regular and established custom of the line. We have lately heard of cases of this kind, where the regular and constant customers of a road paying high fares and meeting with but few accommodations were mortified by finding the attendants of political meetings carried for 25 to 50 per cent less and the company making money even then. This is not as it should be, and that it is unprofitable will soon be proved by a corresponding decrease in the regular traffic of the road.

Some of our best managed and most profitable Railroads are those which, by a vigorous opposition, either by Stage or Steamboat or by both, have been compelled to reduce their fares—and where the experiment entered upon by compulsion has proved finally to be, the best and most judicious permanent policy.

Be this as it may, a reasonable reduction of fare is demanded by the spirit of the times must either he complied with or contended against to the great detriment of those entering into the unequal contest.

ATLANTIC STEAMERS.

Every day furnishes additional proofs of the ease, safety, and certainty of the navigation of the Atlantic by steam. Mr. Cunard has established his line of Steam packets to Boston and Halifax, and as yet they have proved the fastest boats of all engaged in the trade. The *Caledonia* arrived in Boston on the morning of the 3rd inst., having made the passage to Halifax in *eleven* days and thence to Boston in 31 hours which including 17 hours delay in Halifax makes the entire passage *thirteen* days. The *Acadia* another of three Steamers made her passage out in *ten* days from Halifax and *thirteen* from Boston.

The *President* from New York arrived out in *sixteen* days—having on board a heavy cargo. It appears that she had 2,500 barrels of flour, which by an effort on the part of Capt. Fayner, were entered at the custom house the day before the duty advanced 4 shillings per quarter. The result of course was a very handsome speculation on the part of the shippers, which would have been rather smaller had any other means of transportation been resorted to. And yet the President is by no means the fastest of the Steam vessels plying upon the Atlantic, still her time of making the passage is certain and not liable to contingencies of so great extent as in the case of packets.

A circumstance of recent occurrence, showing the rapidity as well as certainty of steam navigation, struck us so forcibly that we were positively

startled—familiar as such things have become. On remarking to a friend that we had not met him for some time past, we were surprised to learn that he had in the interim made a voyage to England, spent sixteen days in the country during which time he had been almost in every part of the Island and returned a fortnight since after an absence of 47 days!

This after all is not as remarkable as what is entirely within the bounds of possibility. A journey of five or six weeks will suffice to carry a Londoner to Niagara falls, the City of Washington, and after a trip of 1000 or 1500 miles in the United States back again, without being hardly missed from his accustomed places of visit. In the same time a New Yorker can visit St. Petersburgh—and before long it will not require a great extension of his journey, as far as time is concerned, to go to Constantinople or even Jerusalem or Cairo.

ERRATA.—In a communication from our friend J. E. B., in our last number of "Railroads v. canals and rivers," quoting J. Edgar Thompson, civil engineers opinion, *that a good railroad will be found to be not only the most* EXPEDITIOUS, *but the* CHEAPEST *artificial medium of conveyance at present known*,"—the article should close as follows:—

☞ With these facts before us, should we not pause, and examine into our canal policy? We ask Western New York to reflect on this subject, ere we are too deep in debt for *canals*, to *aid* railroads.

For the American Railroad Journal and Mechanics' Magazine.

RAMARKS ON THE "LAWS OF TRADE." By Charles Ellet, Jr. Civil Engineer.—No. I.

The determination of the toll proper to be charged on a canal or railroad, for the conveyance of those commodities which are uniformly distributed over the district traversed by the improvement, and which are not objects of competition for rival lines, is an interesting and profitable question for the application of the principles involving the "Laws of Trade." This toll ought to be adjusted with a view to revenue, and, at the same time, a proper regard to equity and to the promotion of the business,—conditions which require variations of the charges corresponding with the changes of position on the line where the trade is received, the price of freight, and other circumstances. But as it is usual with the directors of the public works of the country to fix an uniform charge per ton per mile, and apply it without reference to these circumstances, it is certainly important to know what that charge ought to be in order to produce the greatest revenue, and what is likely to be the consequence of departures from it. The examination of this subject will lead to some curious and not unimportant conclusions.

For the purpose of the investigation, let us designate by

Π the greatest tax for carriage which the commodity will bear;

δ the freight per ton per mile on the improvement;

c the toll per ton per mile;

$\mathfrak{C}=(c+\delta)$ the whole charge per ton per mile;

β the charge per ton per mile on the lateral roads by which trade is conveyed to or from the line; and by

x the distance the commodity is transported on the work.

We shall then have the expression

$$\frac{\Pi}{\mathfrak{C}}$$

for the number of miles which the article will bear to be conveyed on the improvement; and

$$\frac{\Pi-x\mathfrak{C}}{\beta}$$

for the distance which it will bear to be carried laterally to or from the work. The tonnage which reaches the line at any distance x from the mart will be proportional to this expression; and since it is supposed to be furnished by the country on both sides of the improvement, will be represented by

$$T=2t\frac{\Pi-\mathfrak{C}x}{\beta}.$$

The revenue of the work due to the passage of this tonnage, obtained from the distance dx, will be

$$2t\frac{\Pi-\mathfrak{C}x}{\beta}cxdx;$$

t standing for the number of tons furnished by each square mile of the county traversed by the lateral road. By integrating this expression we obtain for the revenue of any distance x

$$r=\frac{3\Pi x^2-2\mathfrak{C}x^3}{3\beta}tc.$$

The greatest distance which the commodity will bear to be conveyed along the line has already been stated at $\frac{\Pi}{\mathfrak{C}}$; so that if we substitute this value in place of x in the equation, we shall obtain

$$R=t\frac{\Pi^3c}{3\beta(c+\delta)^2},$$

for the aggregate revenue which can be derived from the conveyance of the article in question.

This equation is general, and independent of any particular value which might be given to the charge; but to arrive at the most profitable toll we must seek that value of c which will render this expression of the revenue the greatest possible, or $\frac{c}{(c+\delta)^2}$ a maximum. Treating this quantity by the rules of the calculus, we find for the condition of its maximum value

$$c=\delta;$$

that is to say, *to attain the greatest possible revenue from the trade, under an uniform charge, the toll must be just equal to the freight;* or the profit

received from each ton must be just equal to the expense of its carriage.

It may be repeated, that this result applies only to those articles which are designated as of heavy burden and small value; and that, in deducing it, we have regarded as "freight" all expenses incurred in the transportation of one ton, and as "toll" the profit which it yields to the work.

By comparing this result with that which is obtained in the general examination of the most advantageous charge, where the condition of absolute uniformity is not prescribed, we remark an essential difference. There the resulting toll is a function of the charge which the commodity will sustain, of the distance it is carried on the line, and of the charge for freight. In the present case, it varies only with the cost of conveyance, and is independent both of the value of the article, and the position, with reference to the mart, where it attains or passes from the improvement.

BOSTON CONNECTED BY RAILWAYS, WITH ST. LOUIS—ALSO THE COTTON, FLOUR AND PORK MARKETS, WITH THE MANUFACTURES OF NEW ENGLAAD.

The following article from a New Orleans paper should claim the attention of the citizens of New York, and induce united efforts to perfect a line of railways from this city to intersect at Albany a *continuous line* from Maine, to the *central city*, of the valley of the Mississippi.

"The enterprise of connecting St. Louis (in Missouri) with Boston, by a chain of rail-roads, is going forward with prospects of speedy accomplishment. The whole line of the road is already chartered. The distance from St. Louis to Boston is about twelve hundred and seventy-five miles. Of this will be completed next year from Boston to Buffalo, five hundred and thirty-five miles—in Ohio. on the shore of Lake Erie, sixty-three miles—in Michigan, near the south line. sixty-five miles—total, six hundred and sixty-three miles; making more than half the whole distance, and embracing two-thirds of the whole expense. The works in the west are for the present suspended by the want of funds, but it is expected that operations will be resumed actively at an early date. Here is enterprise exhibited on as grand a scale as the wildest fancy could have imagined. Ten years ago a plan to connect Boston with St. Louis would have been regarded as visionary as a scheme to bridge the Atlantic ocean. But a few more years will witness the accomplishment of the project, and the extension of the road perhaps many miles westward. *We are not surprised that the citizens of New York manifest so much alarm at the rivalry of Boston.* She is rapidly extending her arms into the great interior of the west. A line of steamers connects her with Europe, and a population unsurpassed for intelligence and enterprise will profit to the utmoet extent, from the facilities which the inventions and improvements of modern times lend to the extension of commerce."

The remaining half of the line, from Boston to St. Louis, (*by water*,) to wit,—from Buffalo via. lake Erie, Toledo, and the Wabash canal, to the Ohio river, will be in operation, at the close of the year 1841. Canals, however, it would appear, does not satisfy Massachusetts, from her past experience. Canals are not adapted to latitudes, where they can only be used six and a half, to seven months in the year. This is more particularly

the case since the late improvements in the locomotile engine, permits the transit of every class of merchandize, at cheap rates, with *celerity* and *certainty, at all seasons* of the year. To use the language of Gen. Dearborn—"Massachusetts has turned her eagle gaze westward." "This link, (speaking of the western railroad,) "in the lengthened chain of intercommunication unites the pier heads of Boston harbor, and the port of St. Louis—the ocean with the Mississippi." * * * "How imposing is the subject." To carry these enlarged views into execution, the statesmen of Massachusetts have quietly matured their plans, and they have provided the means to carry them into execution. Does Albany want money to connect the outlet of the Erie canal, and the western railroad, with the *pier heads of the long wharf*, named after her? instantly her bonds, to the extent of $650,000 are cashed, and their engineers and agents are sent into our State to make a railroad, to turn our trade to Boston. Does Buffalo want $250,000 to complete "*the terminating link, to reach lake Erie from Attica?*" forthwith a meeting is called of the citizens of Boston, and they provide the means to control the two extremes of our State. What is the object of this liberality? The answer is obvious—to divert by her agents at Buffalo and at Albany, the western trade to Boston, the *great manufacturing emporium* of New England.

We may truly ask how long our Rip Van Winkles will be content to dream, that our State Treasury can furnish means to build the New York and Albany railroad, or further aid the New York and Erie railroad, whilst our statesmen, (without regard to party) remain wedded entirely to our canal system. Works, the construction of which, we assert, will absorb every dollar the state can raise, the next six years, and even when finished, they will remain monuments of the folly of the age, whilst our neglect of railways, is making us the laughing stock of our neighbors.

This view is not hastily presented. It is given after examination into the expense, profits and cheapness of transportation of merchandize by railways, on all great *thoroughfares.* This is particularly the case where there is a dense population on the line of the road, with large cities at the extremities. The longer the line, the greater will be the profit to the link terminating on the sea board, as in the case of the Boston and Worcester railroad; the New York and Albany; the Columbia, the Baltimore and Ohio, and other railroads leading from the sea, to the interior. They must all be profitable, and are destined to change the the course of transportation, of valuable articles. J. E. B.

REPORT OF JAMES RENWICK, L. L. D., ON THE MODE OF SUPPLYING THE ERIE CANAL WITH WATER FROM LOCKPORT TO THE CAYUGA MARSHES.

Columbia College, New York,
4th, September, 1839.

The Hon. F. Whittlesey, Rochester:

In compliance with the request in your letter of the 26th July, I proceeded to the western part of the State for the purpose of examining the

question therein submitted to me, viz.: "What means shall be adopted for the purpose of rendering it certain that the Erie canal shall be wholly fed from Buffalo to the Cayuga marshes without the necessity of taking water from the Genesee river?" In pursuing this inquiry I have received great assistance from the free and frank communication of Nathan S. Roberts, Esq. and Alfred Barrett, Esq. the chief engineers of the two sections of the canal within which the works involved in the question are situated, and from Mr. John Hinds, the superintendant of the Lockport division. In addition, the manuscript reports of the engineers just named were politely placed at my disposal by the Hon. S. B. Ruggles, one of the boards of canal commissioners. I have thus been enabled to consider the question fully in all its bearing, and have arrived at the satisfactory result, that if it be not possible, without making changes in the route of the canal that would be to injurious to existing improvements to be even thought of, to supply the canal as far as the Cayuga marshes directly from lake Erie, still it is possible to effect such supply without drawing water from the Genesee river at seasons when the stream is low, and the whole of it barely sufficient for the supply of the mills. On my arrival at Rochester the first point to which I turned my attention was to ascertain the quantity of water then running in the canal to the eastward, for this purpose the velocity of the canal was measured between the Genesee feeder and the first lock, (No. 1.) The velocity, when reduced to a mean was 24,675 feet per minute, and the discharge 3850 cubic feet. This discharge it was found was effected in part by overflowing at the gate of the lock, and in order to cause this overflow, the depth of water in the aqueduct instead of 4 feet was found to be 4 feet 6 inches.

The superficial velocity of the water in the Genesee feeder was found to differ but little from that in the canal, and it was inferred that all the quantity of water which appeared to be flowing in the canal was drawn from the Genesee river. No farther inquiry on this head was necessary for on proceeding to the Rochester aqueduct, a gentle but decided current was found setting to the westward, showing that the feeder not only supplied all the eastern section, but that a part of the water to the west of Rochester was also drawn from it. It was therefore obvious that no part of the water which descends at Lockport from the lake level reached Rochester, and that the whole supply of the canal to the east of the last mentioned place was at the time of the observation, derived from the Genesee river. According to the best information, such had uniformly been the case, except for a few weeks soon after the completion of the canal, and on certain occasions when the Genesee feeder had been closed for the purpose of repair. Of the latter, an instance which occurred in the summer of 1838, was cited. The Genesee feeder being closed by an embankment, the level of the canal fell until its depth became no more than $2\frac{1}{2}$ feet, beyond which it seemed impracticable to raise it by the flow of water from lake Erie. The same general fact that the water cannot be kept at the lock east of Ro-

chester, within 12 or 18 inches of its proper level when the Genesee feeder is closed is stated in the report of the engineers. The effect of filling the canal by water from the Genesee feeder until it shall overflow at the gate of lock No 1, and stand six inches above its conventional level will be understood, when we consider that the slope of the bed of the canal is half an inch per mile. This rise of six inches will therefore back the water up the canal for a distance of 12 miles, and there will be two conflicting currents, under the action of which, what remains of the water that has been drawn from lake Erie, is forced over a waste wier about two miles to the westward of Rochester, and may be accompanied by a portion of that drawn from the Genesee river. Indeed it may be believed, that the latter is the largest part of what escapes at this waste weir, for the discharge from the weirs between this point and Lockport may at times account for all the water which comes down from the lake level. In this case, not only will be the canal to the eastward of Rochester, derives its whole from the Genesee river, but the waste and leakage for several miles to the westward will be furnished from the same source.

To test this question the currents were examined while making a passage from Rochester to Lockport, and it was found that there was no perceptible current to the eastward until after passing Spencer's basin, 12 miles to the westward of Rochester.

On speaking on this subject with Professor Dewey, he intimated that the western flow of the water in the acqueduct was too familiar an occurrence to excite surprise, and it was to be inferred that he had never noticed it running in a different direction. It may therefore be assumed as an established fact that up to the present time it has been the usual practice of the lock keepers to derive the whole supply of the canal to the eastward of Rochester from the Genesee river; and that in so doing, by forcing it over the lock-gates, the waste and leakage of some miles to the westward has also been furnished from the same source. According to the estimates of the engineers, this has amounted to 100 cubic feet per mile, or 5600 cubic feet per minute for the distance from Rochester to the Cayuga marshes. If these estimates of expenditure be correct, and they would appear to rest on sufficient evidence. This large quantity of water has unquestionably been continually drawn from the Genesee river. How far this may constitute a ground for a claim of indemnity on the part of the owners of the mills is a question into which it is not my province to enter, but there can be no doubt that in seasons of drought they must have sustained most serious injury.

It being thus ascertained that the whole of the canal to the eastward of Rochester, was actually fed from the Genesee river, it was a matter of doubt whether this were rendered necessary by the circumstances of the case, or arose from defective management. A visit to Lockport and Buffalo showed the lake level of the canal at its full depth, while the discharge through the locks was sufficient to keep the canal overflowing at every waste weir.

Finally, within two miles of Rochester, is, as has been remarked, a waste weir, over which a large quantity of water was found constantly pouring. It was intended to have guaged this weir, but the experiment now to be cited was considered of sufficient importance to be preferred.

In consequence of suggestions to the same effect with the foregoing remarks, the gates of the Genesee feeder were closed for the purpose of testing by experiment, whether water from lake Erie could, in the present condition of the canal, reach and be available at Rochester. Provision was made for passing water into the levels beneath without forcing it over the lock-gates. The water in the aqueduct fell speedily from a depth of 4 feet 6 inches to 4 feet. A current now set from the westward, and flowed constantly through the aqueduct. This current was observed by me for about eight hours, during which time there was no farther perceptible reduction in the depth of water in the aqueduct. After twelve hours, however, it became necessary to admit vessels from the Genesee river through the feeder, and the experiment could no longer be persevered in. It appeared also that some vessels had taken the ground in the basin at the junction of the feeder, showing a greater diminution of depth to the eastward of the aqueduct than in the aqueduct itself. From that time, for the next four days, a partial supply was admitted from the river, but not in such a manner as to raise the water in the aqueduct beyond the depth of four feet.

This experiment was commenced without notice or concert, but it is believed that the banks and weirs between Rochester and Lockport, were in better order than has been usual. It may be considered as having conclusively settled the question whether waterand be brought on the canal in its present state, from lake Erie to Rochester in the affirmative, as having proved that the quantity is sufficient for all intermediate objects, and that a surplus is left applicable to the supply of the lower levels; but it may also be considered as proving that this surplus is not sufficient for the latter object. It seemed to be admitted that these levels could not have continued to be supplied had not the Genesee feeder been opened, and it was kept partially open although the current was still directed eastward through the aqueduct. We may therefore assume that it not only has not been usual to draw any part of the supply of the canal to the eastward of Rochester from lake Erie, but that with the canal in its present state it has been impossible to derive the whole of such supply from that distant source. Whether this be an absolute physical impossibility, or whether it arise from errors in the original plan of the canal, from natural causes acting to impair it from faults in its execution, or from defects in the manner in which it has been managed, must be examined before we can proceed to point out the ameliorations in these several directions of which the canal is susceptible.

The quantity of water which it is estimated by the state engineers is consumed by the levels east of Rochester is 5600 cubic feet per minute.

The area of the present canal is 136 feet. The water, therefore should

have a mean velocity of 41.2 feet per minute or 2472 feet per hour. Calculating the proper slope for such a velocity in a canal of the given dimensions, by means of Eytiwein's formula, it would appear to require 1.3 in. per mile, and by the formula of Prony 1.4 in. The slope allowed in the construction of the canal is no more than half an inch per mile. We cannot err therefore, if we assert that the slope of the present canal is little more than one third of what it ought to have been in order to maintain a steady flow of as much water as it is said is used on the canal east of Rochester from Lockport to that place. It is farther to be remarked that each of the 64 miles between Rochester and Lockport, is estimated to consume its 100 cubic feet per minute, and that this ought to be met, either by giving to the canal at the points near Lockport a greater sectional area, or a greater slope.

Were it not that the main object of this report is to point out the means of remedying existing defects, and of preventing their occurrence in the enlarged canal, it would be unnecessary to proceed farther. In this single and prominent cause is to be found a reason all sufficient why the main supply of the canal east of Rochester must have always been drawn from the Genesee river, and this much continued to be the case in the enlarged canal, unless it have a slope and volume adapted to its own wants. The error in management by which not only the whole supply east but that of several miles to the westward of Rochester has usually been drawn from the Genesee river has been already referred to, but although this may be corrected, and no water passed westward through the aqueduct, much of the eastern supply must continue to draw from the river so long as the canal retain its present slope and dimensions. In enlarging the canal a less slope will suffice, the resistance being less in proportion in the larger channels, but in a channel of the area of the new aqueduct at Rochester, a slope of nine tenths of an inch per mile will be required to pass the water demanded for the lower levels. Continuing this same slope up to Lockport, it will amount in all to 57.6 inches, while the present slope is no more than 32 inches.

The descent from the lake level at Lockport, is effected by means of five combined locks, having an united fall of 60 feet. It is foreign to our present object to point out the general defects which attend the combination of locks into a system, instead of separating them by levels of the canal, or at least by extensive basins. It was, we are informed, believed that the mountain ridge could be passed in no other manner, and although a part of the difficulties which have attended this justaposition of the locks was foreseen, it was not believed that it was possible to adopt any other arrangement. This has had an unfortunate influence on the question before us. Had it been known to be possible or considered expedient to have divided the fall which is now accumulated at Lockport, and thus to have laid out the canal in four successive levels of 12 and 20 miles each, the defect in the slope of the bottom of the canal would not have produced so material a deficiency in the supply, for a small accumulation at the head of each level or depression

at its lower end would have caused a slope on the surface of the water in the canal sufficient to give the velocity necessary for the passage of the supply through it. But into a level of 50 or 60 miles, the water may be poured in sufficient abundance to overflow at every waste weir, and yet little more shall reach its lower extremity than if it had been barely kept up to its prescribed depth.

The accumulation of the locks at Lockport, preventing any adaptation of the slope of the surface to the supply acquired to be passed, and throwing this whole duty upon the slope of the bed of the canal may therefore be ranked among the prominent defects of the existing canal. Nor are the objections to a system of combined locks less when they are considered in other points of view. In order that they shall pass as much trade as a single isolated lock, it becomes necessary to have a double set, and thus twice as much water is introduced in lockage at one end of a level as it demanded for the same purpose at the other. If therefore there be no provision for husbanding this excess to meet the waste and lekage, at other points, it must be discharged over the nearest waste weir and then an excessive supply set down at Lockport, and overruning there with a velocity which exceeds the limits of 1-2 to 3-4 inch per hour prescribed by the Commissioners, a large proportion barely enters the Rochester had to be forthwith passed over a weir and all the residue is usually thrown out of the bed of the Canal before it reaches Spencer's basin.

Such is the quantity of water which is thus usually wasted, that mills are to be seen at various points on the line of the Canal, in steady operation, which have in some cases no other supply of water than that which runs over the weirs, and in others although placed on the line of a natural stream, the beds of most of those streams were found dry in the month of August.

Considered as a labour saving engine, a canal is viewed by those who confine themselves to the theory, as a machine, set in action by the water of a reservoir at its summit level, whence it receives it clear and pure, in quantities just sufficient for its lockage, and for the waste by leakage and evaporation; these quantities it conveys neither in excess nor defect to the place where they are respectively needed. In the New York Canals on the contrary, water has been derived from every possible and available source, poured in without measure, whether turbid or clear, to be again thrown to waste, after it has deposited its impurities in the bed of the canal. In other parts of the canal, the necessity of grasping every available stream may have really existed, but when Lake Erie was to be found at the summit no such reason can be assigned. Had the canal been vested in an incorporated company or been in any other hands than that of the sovereign power of the state, it could not have continued in use under the present system of management. The claims for damages for the diversion of waters in such quantities from their regular and ardent courses would have borne no small relation to the nett tolls, if they could have been brought before an impartial jury, nor would a corporation or individual have sub-

mitted to such claims where at least a part of the benefit is reaped by those who make use of the same waters, thrown to waste through another channel.

The worst feature in the present state of the canal is the power either of injury or of conferring benefit which is placed in the hands of subordinate agents. Thus the keeper of the first lock east of Rochester has it in his power by the manner in which he sends down the water to the lower levels, to determine whether the whole of the supply of the canal from Spencers basin to the Cayuga level shall be drawn from the Genessee river, or whether that river shall be required to furnish no more than is deficient in the quantity which is capable of making its way from Lockport. In other places it is possible by the management of a waste gate, to keep a mill in continual operation at the expense of the canal, or prevent it from working at all. Nor can it be credited that prudent men would have trusted to a supply to all appearance so precarious, as that of the mere waste of a canal, which in some places is complained of as insufficiently supplied, had there not been some reasonable assurance that this waste of water, so much wanted in other directions, should continue to be sufficient for their objects. Such is the condition of the present canal that an intelligent workman in a mill on the route, with whom I had a conversation, expressed it as his belief, founded on the experience, that the more water was required on the lower levels, the greater must necessarily be the waste on the upper. Paradoxical as this may appear, it is at the present moment, under the given slope of the canal and position of the waste wiers, true, for in attempting to send forward the desired quantity of water, the canal is filled at every point to overflowing, while, after all, the addition to the quantity which reaches Rochester would be insensible, even were the level kept low enough there to permit it to flow through the aqueduct.

The actual expenditure of water in the existing canal stated by the engineers at 100 cubic feet per mile per minute is due far more to the excessive discharge over the waste gates than to the causes usually assigned, of leakage and evaporation. There are indeed reasons why the loss from leakage should be greater on the line of canal between Lockport and Rochester than in other regions. The excavation in many cases extends downwards into a slaty rock, the joints of which are open and leave a free escape for water. These joints have never been secured by puddling or lining of any description. The soil is in most instances bad, being a light sandy loam. It appears probable, however, that these causes have ceased to be of much moment, for the very filtration of the water through the banks and bed of a canal tends to make them water tight. The nature of the soil, the admission of muddy water and the imperfect structure of the canal had, however, been the cause of an obstruction of no little moment not only to the flow of water from Lockport to Rochester but even to the navigation of the Canal. The bed of the canal has been formed in this loose friable soil of the same figure as was adopted throughout the whole

of the rest of the line, the sides having an inclination of 1 foot in 1 1-2 of breadth. This is far from being sufficient to sustain earth of this quality even if not exposed to the action of water. In the case before us it has been continually worn from the sides and deposited in the angles of the bed, until in the neighbourhood of Holley, the capacity of the canal has been so far diminished that two loaded boats cannot pass each other.

In connection with this obstruction may be cited another known by the boatmen under the name of *side bars.* These appear to be owing to the following cause. The canal is laid for a great part of the distance between Rochester and Lockport, on side lying grounds, and therefore in many cases there is a cut on its southern side. This is continually acted upon by the current, and the wave raised in it by boats, and earth is thus thrown into the canal. In addition, the surface water of the country to the south finds its way for the most part into the canal, carrying with it the loose earth and the wash of the fields. All streams, too, which intersect the line of the canal at a level sufficiently high, are permitted to flow into it, whether clear or turbid. There are in truth none of the arrangements for preventing the canal from being filled up, which have been tested by experience in Europe. The counterbank has never been finished. It has no berm to prevent the wash from its own face from falling down, no counterditch to exclude and carry off surface water, nor can either of these necessary parts to be found in their proper place even in connection with the towing path. Not the least curious observation is that the counterbank of the canal should be familiarly, named the berm from an important and essential feature which it ought to have possessed, but which is not to be found in any part of it. The flow of water through the canal is said in some seasons to be much hindered by the growth of a species of grass. This appears to have been a native of the shores of Lake Erie, and to be making gradual encroachments along the Canal. At the time I passed up, it appeared to have been recently cut, for the surface of the water in the canal was covered with it floating, yet withered. The superintendant of this section is of opinion that he has succeeded in discovering a mode by which the grass may be kept within bounds without difficulty. Still it is of the utmost importance that this should be done, and that it be satisfactorily shown that the cutting of the weed can be performed with certainty, for its presence will render all calculations on the velocity and discharge of the water erroneous.

The aqueduct at Rochester forms at the present moment a bar to the progress of the water Eastward. Its area is less than half that of the canal itself, and the canal on issuing from the aqueduct is bent nearly at right angles. It may thus happen, even when the canal west of the aqueduct, is fully supplied with water that a rapid lockage will leave that part between the acqueduct the lock East of Rochester so shallow as to require a supply from the Genessee river. In general, also, in all cases of frequent passages through a lock the level of the water in the upper reach of the canal is

drawn down unless the canal have a large surface in the immediate vicinity. This will be more particularly the case near the lock which closes a long level when there is no opportunity for increasing the velocity by a change in the slope of the surface caused by a swell or flush in the neighborhood of the lock next above it. So also when there is a defect of water in the lower levels, those above may be drawn upon too rapidly, and vessels caused to take the ground.

In the neighbourhood of the upper lock, the rapid discharge of water used in lockage, raises a wave, which does not for a time communicate its motion to the body of water in the reach when it enters. It will therefore require space to spread itself on an elevation in the banks and waste wiers, in order to prevent these sudden flushes from being unprofitably wasted. The causes which have been observed, as opposing or preventing altogether the flow of the waters from Lake Erie to the levels east of the Genessee river, having been thus premised, the remedies and changes which are necessary in any improvement or enlargement of the canal may be enquired into.

(To be Continued.)

We are gratified to have received from Mr. Vignoles, the following very interesting report of the North Union railroad. We publish it as a sample of the manner of stating railroad disbursements in England. We shall be happy to receive further reports from this gentleman as well as from the several railway companies in England and other parts of Europe, to diffuse information for mutual benefit.

EXTRACTS FROM THE REPORT OF THE DIRECTORS.

Although the act of incorporation of the north union railway company only contemplates the accounts being made up once in the year, in compliance with the wish of the proprietors expressed at the last general meeting, the directors propose to adopt the usual practice of doing so, and declaring a dividend *half-yearly*; submitting the accounts, and the dividend proposed to be declared, to meetings of their proprietors summoned every six months, at similar periods of the year to those of the railway companies generally.

In the statements of the company's accounts, the proprietors will notice that the expenditure on the capital account, that is in the completion of the railway itself, with all the stations, workshops, machinery, engines, carriages, tools, &c. &c. is kept altogether distinct from the receipts and disbursements in the traffic account, or that of the *working* of the railway.

The former account is fast drawing to a close, this railway having now been amply and very satisfactorily furnished with almost all that appears at present requisite for the efficient and economical working of the traffic; and, as regards its locomotive establishments, being even adequate to furnishing power to other connecting railway companies, on terms which it is anticipated will prove *mutually* beneficial.

As regards the traffic account, the proprietors will have pleasure in observing that, although the half-year ending the 30th June is well known not to be so favorable to railway receipts as that terminating on the 31st December, the receipts of the last half-year present a satisfactory comparison with those of the previous one, and have been very considerably more

than those of the corresponding period of 1839. The nett profit of the last half-year, including the surplus of 406*l* 11*s* 5*d* of the previous dividend, amounts to 16,396*l* 3*s* 4*d*; the directors would therefore propose that a dividend of 2*l* 10*s* per share (being at the rate of 6*l* 13*s* 4*d* per cent., per annum on the 75*l* share) be now declared, payable by warrant, at the company s bankers, on or after the 17th instant; leaving a surplus of 537*l* 13*s* 4*d* to be carried to the next half-yearly account.

The directors cannot close their report without stating distinctly to their proprietors, that they are far from considering the entire capabilities of the line as by any means fully developed. The Lancaster and Preston junction railway was only opened at the *close* of the half-year to which these accounts are confined, and the Preston and Wyre railway, which promises to be another very important feeder from its bringing into existence an entirely new traffic, has only been *subsequently* opened to the public; and in addition to these *new* sources of income, the continued increase in all the old branches of business experienced on every railway, may be anticipated with peculiar confidence on this, and most especially as regards the increasing conveyance of goods and coals.

Some inaccurate statements having been circulated relative to the *cost* of this railway, the engineer has prepared and appended to his report a detailed and authentic statement of all the particulars, which the Directors think it only justice to him to have circulated among the proprietors generally, and which is therefore annexed to the following accounts.

RECEIPTS, *&c. to the* 30*th* JUNE, 1840.

Coaching Department	$128,274 92
Coal Ditto	2,079 20
Merchandize Ditto	11,397 86
Rental Account	2,222 22
	$143,974 20
Profit and Loss Account, to 31st December, 1839	1,806 97
	$145,781 17

EXPENSES.

Coach Disbursement Account	$8,812 09
Locomotive Power Account	16,813 72
Office Expenses Account	923 09
Salary Account	3.791 55
Toll (to Liverpool and Manchester Co.) Account	31,954 94
Petty Disbursement Account	56 40
Interest Account	626 44
Interest on Loan Account	3,407 06
Tax and Rate Account	2,231 10
Chief Rents Account	194 07
Charge for Direction Account	1,333 33
Maintenance of Way	2,666 67
Compensation	14
Fire Insurance	11 67
Advertising	10 89
Repairs for Buildings	59 98
	72,907 08

Dividend of 50*s per Share on* 6329 *Shares is* 15,822*l* 10*s*. $72,874 09

THEODORE W. RATHBONE, *Chairman.*

TO THE DIRECTORS OF THE NORTH UNION RAILWAY.

GENTLEMEN,

In drawing to a close the construction of the north union railway, I consider it will be satisfactory to the directors and proprietors to have the detailed cost of the several great heads of expenditure brought into one view before them. It is due to myself and the other officers of the company, that the quantity of work executed for the money should be set forth; and without any thing beyond a simple statement of facts in this respect I shall be content, should this report be promulgated, to leave the shareholders in this concern and the public to form their judgment. I likewise conceive that, as the first authentic detailed document of the kind, it may be taken as the commencement of similar statements which will hereafter be brought forward, and thereby be the means of collecting that statistical information on the railway system, which has naturally, and of late, been so much sought after.

It should be noted that the total length of line embraced herein is 25 miles; the main line from Parkside through Wigan to Preston being 22 miles, and the New Springs Branch 3 miles: and it should be observed, that from the peculiar nature of this Railway, the total extent of sidings, extra lines, &c., is very much above the usual proportion.

In the total sum of 578,931*l* 16*s* 2*d*, (say in round numbers $2,573,000,) is included the cost of re-laying the old line between Parkside and Wigan; the cottages now builing along the line; the maintenance of the railway by the contractors, for two years, from the respective openings; and not only all that has been already expended on the several items, but that which is now in progress, or contemplated to be done, to make the railway complete, and to draw the line at the foot of *capital account.*

From a consideration of the nature of the works on this line, many of them of a gigantic character, particularly the Ribble Viaduct, and including the various slips and accidents, I hope I may be permitted to consider the average cost of $102,920 per mile as a moderate amount, including, as it does, Stations, Carrying Establishments, Interest, and Management.

The actual cost of the railway itself has been only $70,191,11 per mile, exclusive of land; and if the peculiarly heavy expense of the Ribble Viaduct (consisting of five arches of 120 feet span each, erected at a cost of about $199,481 including all contingent extras) be excluded, as it fairly might, for comparative results, the cost of the works alone is $62,213 per mile; the purchase of land for the railway is $8,773 per mile additional; $15,631 is the cost per mile for the stations and carrying establishments; and $8,342 per mile for interest and management. Separating the latter item from the interest, it will be seen that the whole expense of the superintendence of the north union railway, over a period of ten years of greater or less activity, has scarcely exceeded 7 per cent. This item is, of course, not in the engineer's department, but it is due to the managing officer of the company to state the circumstance: it will also be found that the average quantities per mile are—of earth work 116,120 cubic yards, averaging under 19 cts., per yard; of masonry, 4000 cubic yards, averaging $5,02 per yard; and of iron, 287 tons, averaging something below $43,33 per ton.

In respect to the mode in which the difficulties presented by the physical obstructions on the face of the country have been surmounted, by the adoption of gradients of 1 in 100 to a considerable extent, and thereby a vast saving effected in the construction of the railway, I hope to be able to demonstrate, at the close of the first two years' entire working of the line in

October next, that, with the exception of some very little addition to the quantity of fuel, the cost of working the north union railway, reduced to a rate per mile per train, is *below* that of other lines with superior gradients, while the trains and rate of travelling are at least equal to the averages elsewhere; and I feel confident of being able shortly to give a very close approximation of what that average expense is per mile per train, including all the deductions from the gross receipts, before declaring a dividend.

There being then but little difference, as far as observation and experience have hitherto gone, in the cost of working trains of passengers and light goods on railways, differing considerably in gradient, at velocities and with loads such as usually occur, *the high importance of economy in the first construction is self-evident.* It has thus told effectively on the grand junction railway, and I trust will be equally felt on the Midland counties railway, each of which lines, with similar equipments to those on the north union railway, will be found to have cost at about the same rate, or but little exceeding it, say certainly within 25,000*l* per mile. Reducing the whole expenses on the north union railway to round numbers and to a per centage, the account will stand as follows:

		Total.	Per Cent.	Per Mile.
	Earth Work	126,000	22	$22,200
	Masonry	120,000	21	21,300
	Fencing	21,000	$3\frac{1}{2}$	3,600
Upper Works.	Railway laid complete	61,000	$10\frac{1}{2}$	10,700
Upper Works.	Iron	67,000	$11\frac{1}{2}$	12,000
	Land and Damages	50,000	$8\frac{1}{2}$	8,900
	Stations	44,000	$7\frac{1}{2}$	8,000
	Carrying Establishment	44,000	$7\frac{1}{2}$	8,000
	Interest	5,000	$\frac{4}{5}$	900
	Management	42,000	$7\frac{1}{5}$	7,500
		580,000*l*	100	$103,100

But to enable a more critical examination to be made, I shall subjoin the following abstract:

Abstract of the quantities and cost of the works upon the line of the north union railway—25 miles—with the general heads of expenditure in the various departments.

EARTH WORK	2,903,028 cubic yards, (average 10 2-5d per yard)		$558,560 87	
MASONRY AND BRIDGES.	100,265 cubic yards Masonry	502,043 98	534,438 91	
	325 tons Iron Work	17,222 22		
	25,022 cubic feet Timber	14,567 71		
FENCING AND DRAINS.	87,712 lineal yards.—*N. B. This includes Road Diversions, &c. Gates, &c. &c.*		91,258 35	
UPPER WORKS.	6,885 tons of Iron Rails and Chains.	297,026 14	570,578 40	
	91,545 lineal yards of railway laid on blocks & Sleepers, including Ballast, Drains, Walling, Bolts, Keys, Felt, Plugs, and small Materials and Labor.	273,502 26		
				$1,754,786 51
LAND AND DAMAGES.	320 acres for Railway.			219,290 63

STATIONS.	Land for Stations.	76,701 20		
	Station Buildings.	60,397 35		
	Warehouses.	41,182 22	196,791 11	
	Fixtures, Turnplates, and Sundries.	18,510 34		
CARRYING ESTABLISHMENT.	Repairing Shops, Tools, and Fixtures.	52,817 78		390,934 31
	Locomotive Engines, Tenders, &c.	83,837 01	194,143 20	
	Carriages, horse boxes, trucks &c.	57,488 41		
INTEREST.	Interest Account, Rates, Taxes, &c. &c.		21,096 81	
MANAGEMENT.	Parliamentary and Law Expenses.	76,260 67		028,010 80
	Engineering and Surveying.	27,525 72	166,963 98	
	Office Expenses, Travelling, Advertising, &c.	13,933 15		
	Salaries.	69,244 44		
TOTAL COST.		$102,921 21 per mile,—or—		$2,573,030 25

It should also be mentioned that, of the above land there remains to the value of about four or five thousand pounds available for re-sale; and, in conclusion, I trust that the dividend of nearly 7 per cent. per annum out of the clear profits of the railway, since its entire completion and opening throughout, in October, 1838, to the present time, with a prospect of a steady increase, is a sufficient proof of the soundness of the concern; and with my grateful acknowledgments to the directors for their invariable kind support amidst many trying difficulties, now happily surmounted,

I have the honour to subscribe myself,

Their very faithful Servant,

CHARLES VIGNOLES, *Engineer-in-chief.*

4, *Trafalgar-square, London, August* 4, 1840.

KITE'S PATENT SAFETY BEAM.

We take great pleasure in again presenting to our readers a new testimonial in favor of Mr. Kite's useful and humane invention. We call it humane, and it indeed is so, for there is no invention connected with railroads, that has been the means of saving so many lives as this.

It will be perceived from the testimonials, that in the cases of accident, the cars have been able to run the entire trip after breaking the axle. This circumstance alone would be an inducement to the use, of the safety beam, as much time and trouble are thereby saved.

Like many other useful contrivances intended to *prevent* danger, the safety beam, must wait until one or more painful accidents have rendered its introduction on any individual road, no longer to be delayed. The very safety it is intended to produce is apt, in unthinking minds, to beget an indifference upon the subject. Bearing this in mind, we shall not hesitate to renew, from time to time, our notices of this valuable invention, and nothing will give us more pleasure than to publish such testimonials as Mr. Kite may receive.

OFFICE OF THE PHILADELPHIA, WILMINGTON AND BALTIMORE RAILROAD CO.

Wilmington, Del., September 28, 1840.

☞ The undesigned take pleasure in attesting to the value of Mr. Jo-

seph S. Kite's invention of the safety beam axle and hub for railroad cars. They have for some time been applied to passenger cars on this road, and experience has tested that they fully accomplish the object intended. Several instances of the fracture of axles have occurred, and in such the cars have uniformly run the whole distance of the trip with entire safety. Had not this invention been used serious accidents must have occurred.

In short we consider Mr. Kite's invention as completely successful in securing the safety of property and lives in railroad travelling, and should be used on all railroads in the country.

JOHN FRAZIER, Agent.
JAS. ELLIOTT, Superintendant Motive Power.
GEORGE CRAIG, Superintendant,
W. L. ASHMEAD, Agent.

ST. LOUIS AND BOSTON.

The two cities of the United States which are progressing most rapidly in population and wealth, at the present time, in proportion to their size, are undoubtedly, Boston and St. Louis, one in the eastern, the other in the western section of the Union. For many years—from 1800 to 1830—Boston was losing ground, in the race for greatness with New York, Philadelphia and Baltimore—but about the year 1830, a new era dawned on that city, through the instrumentality of its enterprising capitalists, which has turned the tide strongly in its favor. At that time the first railroad was constructed on one side of the city, and the first steam power loom establishment erected on the other. From that time to the present, Lowel has increased in population from 200 to 20,000, and in wealth, from $100,000 to $20,000,000. The cotton manufacture of Lowel, and the hundred other manufacturing villages in New England, have given a stability to the trade of Boston, unknown to any other city in the Uuion.

Massachusetts, which formerly exported, it was said, nothing but granite and ice, now produces manufactures valued at ninety millions of dollars per annum, a large part of which centres at Boston, as a place of distribution to all parts of the Union.

At a later period than that first mentioned, her far-seeing citizens became convinced, that although she had no river like the Hudson, the Delaware, or the Susquehanna, to bring to her wharves the products of the boundless and fertile west, yet that an iron pathway might be laid along her mountain gorges, over which a steam engine with a train of cars could move at the rate of thirty miles per hour, taking the produce of the lakes at the outlet of the New York canal, and landing it at Boston in less time than it can be delivered at New York. About one half of this road is completed, and the whole will be finished within twelve months from this time.

This road will cost not far from seven millions of dollars. It is calculated to support an engine of fourteen tons weight, and to carry 1000 barrels of flour in a single train of cars, ten miles an hour. It is estimated that when finished flour, can be transported from Albany to Boston, 201 miles, for 30 cents per barrel. Two thousand men are now at work on this road, in some sections, both night and day. The capitalists of Boston have also contributed largely to the funds required for laying down railways from Albany to Buffalo, between which places there will soon be a continuous line completed. The same enterprise and capital will, ere many years shall have elapsed, continue the same line across Ohio, Indiana, and Illinois, to St. Louis, in case the funds required for the work are not furnished by the States on the route.

The trade between this city and Boston is greater, and the connexion more intimate, than is generally imagined. The various staple articles of export from Boston, including domestic goods, boots and shoes, oil, candles, &c., required for this market and which are forwarded from here for the upper country, cannot fall short of two millions of dollars.

We shall close these remarks with a comparative statement of the value of western productions shipped from New Orleans to New York and Boston.

	New York.	Boston.
Tobacco,	560,000	160,000
Cotton,	1,880,000	2,120,000
Flour,	228,000	156,000
Pork,	570,000	324,000
Bacon,	109,000	50,000
Lard,	36,000	149,000
Beef,	3,200	11,000
Corn,	15,000	12,000
Lead.	270,000	353,000
Total,	3,371,000	3,334,000

The foregoing, taken from a Boston paper, proves the concert of action between Boston and St. Louis. In a previous communication from a New Orleans paper, surprise was expressed at the apathy of New York, in view of the exertions of Boston, to tap, and take from New York a still larger share of the rich and increasing trade from the vallies of the Ohio the Mississippi and the Missouri rivers.

"Two facts are disclosed, in the "*comparative statement of the value of products, shipped from New Orleans to Boston*" which surprised us. We allude to the value of cotton shipped to Boston (at the close of the last season) exceeding in value, the amount shipped to New York, by $240,-000, whilst the previous season it was in favor of New York 12,012 bales, or $480,000.

ADVANTAGES OF COMPRESSED PEAT. By Alexander S. Byrne.

(Continued from page 221)

In a former paper on this subject I omitted to notice a useful application of peat, of considerable importance to persons resident in districts where peat and vegetable *mosses* abound. I allude to the manufacture of beds. For this purpose, mosses are equal in value to the finest feathers; being equally soft and pleasant, more durable, more cleanly, more elastic, and healthful. They are also less costly; for a few shillings the comforts of a good bed can be obtained, superior in many respects to hair or feathers.

The idea occurred to me about twelve monts ago, while exploring the interior of the bogs of Allen; and I immediately tested its beneficial effect, by directing the peasantry of Robertstown to manufacture several large beds and occupy them for a few months. The result has proved highly satisfactory; and, I have no doubt, will induce many of the wealthier classes to provide for the comforts of their poorer countrymen during the inclemency of winter.

The *top* surface of turf lands and bogs consists of strong, fine peat, called *turf moss*, composed of very thin vegetable fibre, delicate, soft and elastic, like whip-cord or strong thread. When properly dried in the open air,

or in drying rooms, and well shaken up, to separate the threads, it will bear considerable pressure without *matting* or losing its elasticity; and there are many reasons for supposing that these properties are retained for a number of years. I have seen thousands of acres that had been exposed to severe trials for a long period of time, without undergoing decomposition. More pleasant and agreeable beds cannot be conceived. They possess all the advantages of horse hair and springs; and from the great softness and elasticity of the fibre, possess the accommodating properties of fine feathers. They are certainly more healthful, because more easily cleansed. Fetid air and unhealthy exhalations from the human body adhere less tenaciously, and it requires less time to cleanse and sweeten them.

In Lapland, the reindeer moss is invariably used for infants to repose on, being softer than any other description of bedding; and in the Cape de Verd islands, a moss somewhat resembling Carrigan moss, (only more thready and fibrous) is generally employed, *by preference*, as a substitute for feathers.

I am not sufficiently acquainted with botany to point out the varieties that are best suited for this purpose; but I have found that almost every description of "top turf," or "bog moss," consisting of thin threads interwoven together, is suited to the purpose when perfectly dried; and I strongly recommend *residents in the back woods* to fill a tick, and make at least one trial with such as they have. I saw some top-surface moss in the woods of Canada, well suited for this purpose, and have no doubt the same description may be found throughout the United States. It would save emigrants both trouble and expense, were such mosses usefully employed, and add much to their comforts.

Some kinds of turf will not answer, owing to their extreme softness and want of elasticity; the heat and moisture of the body causes them to adhere and become matted, or if dried too much, they lose their cohesive properties, become brittle, and break into small pieces like straw. These varieties, however, are the exception, not the general rule. Those who wish to make success more sure will find it advantageous to soak the moss for a few days in a solution of pyroligneous acid, (proportions, 1 pint of acid to 1 gallon of water) or in alum water, (proportions, 1 lb. of alum to 1 gallon water); or a solution of silicate of potash will answer. Corrosive sublimate in solution is still better, or a solution of sulphate of zinc; the former having an astringent quality for binding and preserving the fibre, and the additional property of *coagulating* the vegetable albumen, which materially improves the mosses, and preserves them from rot. It is this property in corrosive sublimate which renders it so valuable in the preservation of timber.

I would here remark in reference to mosses, that when calcined in air-tight retorts, or air-tight vessels of any other kind, with a small aperture for the volatile products to escape, they yield a fine charcoal, which is highly valuable in the manufacture of pigments, tooth powder, and blacking; for which purposes calcined mosses are superior to any other article. They are equally good for such applications after they have been used for bedding.

For the instruction of persons unacquainted with manufactures, I remark, that calcination is effected in vessels heated red-hot, the atmosphere being excluded, and a small aperture left for the gaseous products to escape; when all the gasses are driven off, the process is complete. This may be easily ascertained by applying a piece of lighted paper to the aperture; if it does not ignite, the volatile products have passed off.

One pound of moss or *top turf* charcoal, 1 lb. of treacle, 2 oz. of oil, and

4 oz. of oil of vitriol, mixed with three pints of cider, vinegar, or old beer, makes a blacking equal to the finest lustre. The vitriol should be added after the other ingredients are mixed.

We now resume the consideration of the subjects enumerated in our former paper; and first—the manufacture of iron by means of peat coke.

Charcoal iron, made by means of heat obtained from wood charcoal, is the best known at present in the markets; such is its value and superiority, that large quantities are annually imported into England from India and Sweden, and sold at the enormous price of 36*l* per ton, while English coke iron is sold at one-fifth the price. In considering this part of our subject, we shall endeavor to prove that peat coke *is of greater value* than the best charcoal, and that in the manufacture of iron it stands unrivalled as a fuel. Being a pure vegetable charcoal, it possesses heating properties analogous to wood charcoal, is equally free from those deleterious ingredients which abound in coal; and when properly compressed as recommended by Mr. Charles Williams of Dublin, or Mr. White of London, or as stated in our last paper, two tons of peat coke occupy *the same space* as *one* of charcoal; consequently, where *intensity of heat* is an object, *twice as much heat* can be obtained from peat coke as from the *hardest and closest* charcoal.

Before we enter upon the consideration of this question, we will give the particulars of an analysis of an inferior quality of peat which we gathered from the interior of the bogs of Allen with a view of ascertaining its calorific power. It was made with considerable care, by Mr. Charles Cowper, of the Royal Adelaide Gallery, London, and we have tested the accuracy of his report in several analysis since.

The calorific power was tried by the litharge test, recommended by Berthier, and employed by Mr. Everitt. This consists in mixing a given weight of the fuel with a sufficient quantity of litharge, and heating it in a crucible; the heating power is in proportion to the quantity of lead reduced. Thus, according to Berthier—

10 grs. of pure carbon gives of lead,	340 grs.
10 grs. of good wood charcoal, from	300 to 323 grs.
10 grs. of dry woods, from	120 to 140 grs.
10 grs. of good coke, from	260 to 285 grs.

According to Mr. Everitt's experiment—

10 grs. of peat coke, picked surface, gave	277 grs.
10 grs. of peat coke, *lower* strata	250 grs.
10 grs. of pressed peat	137 grs.

By Mr. Cowper's experiments, the following results were obtained, being averages of six or eight experiments each:

10 grs. of good Newcastle coal gave	284 grs.
10 grs. of oven coke	302 grs.
10 grs. of common peat	144 grs.
10 grs. of same, coked in a crucible	259 grs.

For the information of those who are unacquainted with this subject, we would observe that the foregoing analysis is founded upon a well known fact—that the quantity of heat generated during the combustion of any fuel is in exact relation to the quantity of oxygen consumed in the process; it being ascertained that *oxygen* supports combustion. Hence, in order to ascertain the relative calorific powers of fuels, *it is only necessary to ascertain the quantity of oxygen each consumes in burning.*

By an average of two experiments made in a platinum crucible, the peat was found to yield 37⅓ per cent of coke, and 3⅜ of ash; and the coke,

9 per cent of ash. The coke is light and friable, and the peat does not swell in coking like Newcastle coal. Thus, it will be seen that two tons of ordinary *uncompressed* peat are equal to one ton of Newcastle coal, and 7 tons of peat coke are equal to 6 tons of good coal coke. The coke gives about two-thirds as much heat as the peat from which it is obtained. It should however be remembered, in comparing peat coke with coke obtained from coal, that two tons of the former, when made from *compressed* peat, occupy the same space as one and a half of the latter; consequently the amount of heat present in the same furnace would be nearly one third more, beside which peat coke is always free from sulphur and other deleterious matter so noxious to the smelter.

As wood charcoal is on many accounts superior to coke from coal in the manufacture of iron, we will not allude further to the latter, but confine our observations as much as possible to the former, in order to ascertain the true value of peat coke.

Prof. Everitt gives the following statement of his experiments in reference to this point, which, he observes, were made with great accuracy; and as the result of our own experiments correspond so nearly with his, we prefer giving his report as an authority. The density (or specific gravity) of

Water,	1000
Compressed peat,	1160
" " less pressed,	910
Peat coke, hard pressed,	1040
" " less pressed,	913
Hardest and dry woods (such as oak, etc.)	800 to 835
Lighter woods (such as poplar, pine, etc.)	383 to 530
Charcoal from hard woods,	400 to 625

Hence we see that the hardest compressed peat is denser than the hardest woods in the relation of 1160 to 835; and compared with some of the lighter woods, nearly double. Further, that the coke prepared from compressed peat is nearly double the density or ordinary charcoal. In common practice it is reckoned that 100 lbs. of charcoal occupy the same space as 200 lbs. of coke. Peat coke would occupy, weight for weight, the same space as common coke.

Pofessor Everitt further remarks: "From my trials, I am of opinion; —1. That the peat coke examined by me (common Lancashire turf,) contains nothing which would, during the burning, be more injurious to iron than *wood charcoal* or the *best* coke, whether it be used to work iron, or under boilers for the generation of steam—2. That it is equal to *the best coke*, weight for weight; and in heating power a little inferior, weight for weight, to wood charcoal, where quantity of each is the only consideration; but where bulk of stowage and *high intensity of heat** are important considerations, it is *superior* to wood charcoal."

The peat examined by Prof. Everitt was common Lancashire peat; but I have found numerous tracts which excel it in purity and calorific power, and contain a much smaller proportion of combustible matter. I have also frequently compressed peat, by means of a stamper press and the use of heat, to a density exceeding that examined by Everitt in the proportion of 1359 to 1160; the density, therefore, of peat coke may be proportionably increased, in relation to ordinary charcoal, as 1120 to 500.

It must be evident from the foregoing remarks, that peat coke is of greater value in the manufacture of iron than the best wood charcoal, (*unless by*

*In smelting iron, this is the chief consideration.—A. S. B.

softening wood, compression to the same density couldb e attained) affording, as I have clearly shown, the important property of high intensity of heat in a small space, and the absence of all deleterious mixtures. Its advantages in this branch of trade should arouse public attention, and induce possessors of turf lands to bring this kind of coke into general use.

But in the manufacture of iron it is not necessaay to coke or compress peat in order to use it benficially, as on account of its purity and density it is equal to wood charcoal, and in some respects superior to coal. We have seen it used in forges and in blast furnaces with the greatest advantage. Henry Scale, Esq., one of the proprietors of the Aberdare iron works, Glamorganshire, informed us that successful experiments had been made in Wales. Mr. William Jones, furnace manager at Mr. Crawshay's works, Hirwain, in the same county, and Mr. Taylor of Hirwain, (both eye-witnesses) informed us, that in the year 1838, a trial of peat in its natural state was made at the Hirwain iron works, near Aberdare, to ascertain its value in smelting iron. The proportions were about four-fifths of common coke from coal and one-fifth of peat. Now mark the results: The quality of the iron produced was *cast* iron, "First Foundry," (called No. 1 Foundry.) The trial was continued for a few days with equal success; but as there is little peat in that district, it was not followed up, for fear of giving an advantage to manufacturers residing in peat counties.

The quality of the iron previous to the application of the peat was what is technically called "white iron," the most inferior desciption; but the result of the experiment was the production of "gray iron," of a highly carburetted character, technically called "foundry." The peat was of the black class, and used as it came from the bog, many portions being quite wet.

We heard in a letter from Mr. John Evens, of (Sir John Guest's) Dowlas iron works, that Mr. W. Daniell, of Abercarn, occasionally used peat in his chaferies, in lieu of charcoal. We addressed him a letter, and received the following answer:—

Dear Sir:—In reply to yours of the 24th inst. I remark, the mode I used peat was mixed with charcoal, say two-thirds charcoal and one-third dried peat. I made the *very best iron* for tin plate. The iron was made in a finery. I think it possible *to use peat alone.* I have not seen any of the Irish peat compressed, and therefore cannot give an opinion whether it can be used in blast furnaces to advantage or not.

I am, dear sir, your ob't. serv't.,

William Daniell.

Perhaps one reason why good peat is preferable to any other article in smelting iron ores, welding, softening steel plates, etc. is, that the excess of carburetted hydrogen known to exist in such substances, and the quality of the gaseous products generally act more readily upon metalic bodies. It is certain that iron works more "kindly," as it is termed, and is sooner brought to a welding heat by the use of peat than with any other fuel.—*American Repertory.*

EARTHQUAKE IN CONNECTICUT, &c.

On Sunday, August 9, 1840, a shock of an earthquake was distinctly perceived in many parts of Connecticut, and at Hartford was so severe as to cause considerable alarm, especially in the churches in which many people were assembled, and out of one of them they rushed with precipitation.

"In New Haven it was not perceived at all by the people assembled in

the churches, and the trembling was slightly felt by one or two persons in their own dwellings. In one house two persons lying down were aroused by the shaking of the bed and the rattling of the window blinds; the house is of brick. At North Milford, six miles west of New Haven, it was not perceived. At Milford, still further west, and at Bridgeport, it was felt and heard distinctly Hence we hear of it to the north and northeast, as very distinct in a part at least of Derby, in Waterbury, Middlebury and Woodbury, nine to twenty-five miles from New Haven; and still more distinctly, it is reported, in Washington, yet in Watertown it was not noticed at all. Further north, we trace it through Farmington and Simsbury, ten and fifteen miles from Hartford. The report is, that it was not observed in Hartland and other towns in the north of Litchfield county. It was very perceptible in some parts of Massachusetts—not at all in Westfield. In Worcester county it was severe. In Boston there was nothing of it. It extended into Tolland county, in this State. Between Hartford and New Haven, it was severely felt in Meriden, not at all in Wallingford, nor we believe at Berlin. At Middletown there was a slight shock. From most of these places we have our information direct, yet it is probable that in some cases in which our informant had not noticed it or heard of it, it may have been perceived by others in the neighborhood.

"The noise was thought by some to proceed from east to west, and by others from northeast to southwest.

"We learn also that the shock was noticed distinctly at Clinton, about twenty-five miles east of New Haven, also at Woodbridge and Wolcott. The noise is compared by different persons to the roll of thunder, the rumbling of a carriage, and the roar of a chimney on fire."*

Some persons have been disposed to attribute this earthquake to the explosion of a meteor. It is true that the explosion of meteors does sometimes produce this effect, as happened Feb. 2, 1766, in Rhode Island and Massachusetts, and at Charleston, South Carolina, in November of the same year, and remarkably at Weston, Connecticut, December, 1807. But there is in the present case no distinct evidence of the transit of a meteor, no such body having been observed,† nor have any fragments been reported as having fallen from the atmosphere.

The great seat of American earthquakes being on the western side of the continent, comparatively few events of this nature have been observed on the eastern side since Europeans have become acquainted with the western hemisphere.

An interesting account of the earthquakes of New England was given to the American Academy of Boston by Prof. Williams, in the volume of their Transactions for 1785, and the remarkable facts described in it might well form the subject of a distinct notice, for which we have not now room. What we have at our disposition shall be devoted to a scene of local disturbance in Connecticut which has been observed ever since the settlement of the country. The region is around East Haddam, on the Connecticut river, a few miles below Middletown. The following memorandum was by request communicated to the senior editor of this Journal twenty-five years ago, by the late Rev. Henry Chapman,‡ and it has been kept on file with the expectation of making an investigation on the spot; but, as that which has been so long delayed may never be done, we are induced to give the fragment on the present occasion.

* Hartford and New Haven Congregational Observer.
† The atmosphere was clear, and the sun shining bright, which might have rendered a fiery meteor invisible, unless its ignition had been very intense.
‡ Who died in Arkansaw, as a missionary.

"In attempting to give an account of the circumstances attendant on subterranean noises, so frequently heard at East Haddam, perhaps it may be proper to mention the common opinion respecting them.

"East Haddam was called by the natives Morehemoodus, or *place of noises*, and a numerous tribe of cannibals resided there. They were famous for worshipping the evil spirit, to appease his wrath. Their account of the occasion of the noises is, 'that the Indian god was angry because the English god intruded upon him, and those were the expressions of his displeasure.' Hence it has been imagined that they originated after the arrival of the English in this country.

"About fifty years ago, an European by the name of Steele came into the place and boarded in the family of a Mr. Knowlton for a short period. He was a man of intelligence, and supposed to be in disguise. He told Mr. Knowlton in confidence, that he had discovered the place of a fossil which he called a carbuncle, and that he should be able to procure it in a few days. Accordingly, he soon after brought home a white round substance resembling a stone in the light, but became remarkably luminous in the dark. It was his practice to labor after his mineral in the night season. The night on which he procured it he secreted it in Mr. K.'s cellar, which was without windows, yet its illuminating power was so great that the house appeared to be on fire, and was seen at a great distance. The next morning he enclosed it in sheet lead, and departed for Europe, and has never since been heard of. It is rumored that he was murdered on his way by the ship's crew. He said that this substance was the cause of the noises—that a change of temperature collects the moistness of the atmosphere, which causes an explosion.

"He further observed, that there would be no more noises for twelve or fifteen years, and then they would be heard again in consequence of the explosion of some small pieces of this substance which he had left, which would by that time become sufficiently large to produce the effect. It is reported that his prediction was strikingly fulfilled. These circumstances are currently reported, and as they are recollected and often spoken of by many respectable old people, they are generally believed.

"Perhaps these stories may only serve as instances of public credulity, but as they are in the mouth of every one who says any thing about this subject, I thought it might not be improper briefly to communicate them.*

'These shocks are generally perceived in the neighboring towns, and sometimes at a great distance. They begin with a trembling of the earth, and a rumbling noise nearly resembling the discharge of very heavy cannon at a distance. Sometimes three or four follow each other in quick succession, and in this case the first is generally the most powerful.

"While I was pursuing my inquiries concerning this subject, I was so fortunate as to find a register, in which was recorded a collection of observations on the state and changes of the atmosphere, the tides, and in short the most remarkable occurrences of the last thirty years, which were noted at the time, with some of the attendant circumstances. From this I copied in short notes an account of the Moodus noises since that period, which I here subjoin in detail.

"The first which was recorded occurred on the 16th of May, 1791. It began at 8 o'clock, P. M. with two very heavy shocks in quick succession. The first was the most powerful; the earth appeared to undergo very violent convulsions. The stone walls were shaken down, chimnies were un-

* It is almost unnecessary to say, that these foolish stories are deserving of no credit whatever, and they are here preserved only as a part of the legends of the day.—Eds.

topped, doors which were latched were thrown open, and a fissure in the ground of several rods in extent was afterwards discovered. Thirty lighter ones succeeded in a short time, and upwards of one hundred were counted in the course of the night.

"This shock was felt at a great distance. It was so severe at Killingworth, (about twenty miles distant,) that a Capt. Benedict, who was walking the deck of his vessel, then lying in the harbor of that place, observed the fish to leap out of water in every direction as far as his eye could reach.

"The atmosphere was perfectly clear and pleasant, and the moon, which was near its full, shone remarkably bright. On the night of the 17th, six more were observed. The atmosphere was still clear and warm.

"The next occurred August, 28th, 1792, at 10 o'clock, P. M. Rain in the forenoon, wind at the eastward. In the afternoon the wind was southwest. Warm and somewhat squally.

"October 24th, 1792, at 1 o'clock in the morning, occurred three shocks. Very pleasant weather—wind southwest.

"Another was observed on the 11th of January, 1793, at 8 o'clock, A. M. The weather was very pleasant and warm. It thawed.

"There was another on the 6th of July, at 6 o'clock in the morning. Very warm and damp. Rain with thunder in the afternoon.

"March 9th, 1794, at 2 o'clock, P. M. there were two, and a third at 11 o'clock, P. M. The atmosphere was clear in the morning, hazy and damp in the afternoon.

"Two others were observed on the 11th of August, 1805, at 7 o'clock, P. M. Wind southwest in the forenoon, and a thunder storm about 4 o'clock, P. M.

"Another occurred on the 30th December, at 6 o'clock, A. M. The atmosphere was moist.

"There were two others on the 9th of February, 1812, at 9 o'clock in the forenoon. Weather was clear, and the wind southerly.

"Another was observed on the 5th of July, at 8 o'clock in the forenoon. The atmosphere was filled with rain and mist.

"The last was on December 28th, 1813, at 4 o'clock in the afternoon. The weather was damp, and thawed the snow fast.

"This account has been several times interrupted by the ill health of the gentleman who kept it. These periods have been frequently of considerable length, and in all probability in these intervals many of these occurrences were omitted.

"The particular place where these explosions originate, has not been ascertained. It appears to be near the northwest corner of the town. It was near this place that Steele found his fossil. The place where the ground was broken when the first one occurred which I mentioned above, was about three and a half miles from this place. There was no appearance of a deposit near where the ground was broken, but it has been observed that this place has been repeatedly struck with lightning.

"The above is the amount of the information which I collected on this subject. I am conscious of the insignificance of some of it; but these stories were blended with all the virtual information which I could find. For this reason I have written them."

The Haddam earthquakes were described more than a century ago by the Rev. Mr. Hosmer, of Haddam, in a letter to Mr. Prince, of Boston, dated Aug. 13, 1729, and recorded in Trumbull's History of Connecticut, (Vol. II, p. 92,) from which the following passages are extracted: they have the tinge of the times, which only adds to their credibility.

"As to the earthquakes," he observes, "I have something considerable

and awful to tell you. Earthquakes have been here, (and no where but in this precinct, as can be discerned; that is, they seem to have their centre, rise and origin among us,) as has been observed for more than thirty years. I have been informed, that in this place, before the English settlements, there were great numbers of Indian inhabitants, and that it was a place of extraordinary *Indian pawaws*, or in short, that it was a place where the Indians drove a prodigious trade at worshipping the devil. Also I was informed, that, many years past, an old Indian was asked what was the reason of the noises in this place? To which he replied, that the Indian's God was very angry because Englishman's God was come here.

"Now whether there be any thing diabolical in these things, I know not; but this I know, that God Almighty is to be seen and trembled at, in what has been often heard among us. Whether it be fire or air distressed in the subterraneous caverns of the earth, cannot be known; for there is no eruption, no explosion perceptible, but by sounds and tremors, which sometimes are very fearful and dreadful. I have myself heard eight or ten sounds successively, and imitating small arms, in the space of five minutes. I have, I suppose, heard several hundreds of them within twenty years; some more, some less terrible. Sometimes we have heard them almost every day, and great numbers of them in the space of a year. Oftentimes I have observed them to be coming down from the north, imitating slow thunder, until the sound came near or right under, and then there seemed to be a breaking like the noise of a cannon shot, or severe thunder, which shakes the houses and all that is in them. They have in a manner ceased, since the great earthquake. As I remember, there have been but two heard since that time, and those but moderate."

Dr. Trumbull, without giving an exact date, goes on to remark in his history: "A worthy gentleman, about six years since, gave the following account of them."*—"The awful noises, of which Mr. Hosmer gave an account, in his historical minutes, and concerning which you desire further information, continue to the present time. The effects they produce, are various as the intermediate degrees between the roar of a cannon and the noise of a pistol. The concussions of the earth, made at the same time, are as much diversified as the sounds in the air. The shock they give to a dwelling house, is the same as the falling of logs on the floor. The smaller shocks produced no emotions of terror or fear in the minds of the inhabitants. They are spoken of as usual occurrences, and are called Moodus noises. But when they are so violent as to be heard in the adjacent towns, they are called earthquakes. During my residence here, which has been almost thirty-six years, I have invariably observed, after some of the most violent of these shocks, that an account has been published in the newspapers, of a small shock of an earthquake, at New London and Hartford. Nor do I believe, in all that period, there has been an account published of an earthquake in Connecticut, which was not far more violent here than in any other place. By recurring to the newspapers, you will find, that an earthquake was noticed on the 18th May, 1791, about 10 o'clock, P. M. It was perceived as far distant as Boston and New York. A few minutes after there was another shock, which was perceptible at the distance of seventy miles. Here, at that time, the concussion of the earth, and the roaring of the atmosphere, were most tremendous. Consternation and dread filled every house. Many chimnies were untopped and walls thrown down. It was a night much to be remembered; for besides the two shocks which

* As the venerable historian placed the MS. of his second volume confidentially in the hands of the senior editor of this Journal in the year 1810, the letter alluded to above must have been written about the beginning of the present century.

were noticed at a distance, during the night there was here a succession of shocks, to the number of twenty, perhaps thirty; the effects of which, like all others, decreased in every direction, in proportion to the distances. The next day, stones of several tons weight, were found removed from their places; and apertures in the earth, and fissures in immovable rocks, ascertained where the explosions were made. Since that time the noises and shocks have been less frequent than before; though not a year passes over us but some of them are perceptible."

It appears that the earthquake was perceived at Middle Haddam on the present occasion. The country in that region is of granite, gneiss, and other primary rocks, and has during many years been famous for its fine crystallized minerals,—beryl and emerald, chrysoberyl, tourmaline, garnet, columbite, &c. Its numerous quarries afford the most magnificent slabs of hornblende gneiss for pavements, and supply distant parts of the United States; and porcelain feldspar has been obtained there by hundreds of tons for exportation. A few miles above, (north,) the primary changes to red sandstone, with trap; and near this junction is a lead mine, formerly wrought, but now abandoned. A trap dyke of vast extent intersects the country, running from the coast at Guilford a great way inland.

In Middle Haddam, near the centre of the well known Moodus noises, "the shock was quite severe." The direction was thought to be from west to east, but not exactly in a line with the stratification of the country. The above remark is quoted from an observer by the Rev. Mr. Brewer, late missionary in Smyrna.* The same gentleman adds the following facts. Being at Chester on the day of the earthquake, (August 9,) a few miles below East Haddam, on the Connecticut River, he observed the jar to be equal in violence to one half of some 15 or 20 shocks to which he had been annually accustomed for a course of years in Smyrna. He thinks that the rumbling may have continued half a minute, and that its course was from N. W. to S. E., nearly in the direction of the strata. It was perceived at Westbrook, Haddam and Wethersfield.

Mr. B. thinks that the earthquakes in Connecticut all proceed from the Moodus Hill, called Mount Tom. He observes that Smyrna was destroyed by an earthquake A. D. 177, and that the catastrophe has been several times repeated, "but generally speaking, its numerous annual earthquakes extend over a circumference of probably not more than 20 or 30 miles, and are ordinarily so slight as barely to arouse one out of sleep, and seldom if ever does any rumbling accompany the shock." "Besides their limited extent, there are hot springs about five miles from the city, under the foot of Mount Corea, which go to prove them of local origin."

Nothing has, we believe, been suggested regarding the cause of the Haddam convulsions, worthy of confidence. The old story of fermenting or decomposing pyrites has been repeated, but this cause seems quite inadequate to account for movements extending at intervals through centuries.

ACCOUNT AND DESCRIPTION OF YOUGHAL BRIDGE, DESIGNED BY ALEXANDER NIMMO. By John E. Jones, A. Inst. C. E.

Youghal, a town in the south of Ireland, county of Cork, celebrated as being the place in which the potatoe was first planted in Irish soil, by Sir Walter Raleigh, is a sea-port of considerable trade, situated on the river Blackwater, which separates it from the adjoining county of Waterford.

Until the building of the present bridge, a dangerous ferry of nearly half

* In the Hartford and New Haven Congregational Observer, of Aug. 29, 1840.

a mile was the only means of communication at this point between the two counties, except by going a distance of sixteen miles by the bridge of Lismore.

The erection of a bridge, which had been for many years in contemplation, was at length decided upon by the principal inhabitants of Youghal, and the late Mr. Nimmo, then employed as government engineer in Ireland, was applied to. He accordingly gave two designs, one for a suspension bridge at Rencrue, where the river narrows, the other, a timber one, within a mile of the town; the latter was preferred for many reasons, viz.: from its requiring an embankment to be made to low water mark, a distance of fifteen hundred feet, forming one side of a triangle, which, when completed, would enclose a tract of ground nearly four hundred acres in extent, and would also save much trouble and difficulty in forming the new line of road to join the old one leading from Waterford to Cork; but principally from its economy, there being ten thousand pounds difference in the estimates.

It was commenced in the year 1829 under my superintendence, and finished in the year 1832.

DESCRIPTION OF BRIDGE.

Its site is upon an arm of the sea, which forms the mouth of the river Blackwater, the rise and fall are sixteen feet each tide, the rapidity of the flow being so great as to increase one half its height in the first quarter.

There are two channels, east and west, separated by a bank of sand, the tail of which passes under the centre of the bridge and is scarcely covered at low water. The quay on the Waterford or western side is two hundred feet square, and its channel upwards of twenty feet deep at the lowest spring tides; from this circumstance it was considered the best place for the bascule, which was for the accommodation of the larger trading vessels, the smaller being enabled, like those on the Thames, to pass under by lowering their masts. The embankment on the eastern side is fifteen hundred feet in length. The face walls are built in good dry rubble work, varying in height from two to twenty feet, along which line there is a belting course laid in mortar, to support the parapet, which is four feet high and two feet thick, that next the sea having a curved batter of six inches to the foot; the upper face two inches to the foot; top of the wall is two feet six in breadth, with counterforts five by four and ten feet apart; the road is thirty feet broad, and there is a footpath on either side of six feet.

The foundation for the walls was formed by placing a heap of loose stones about six feet in depth along the entire line; upon this were deposited the materials for the future wall. This weight sunk the stones a considerable way into the sand. The filling was thrown in, and the whole allowed to remain in that state for twelve months, during which time, if any part of it sank, there was more added, until it at last became one firm mass. The temporary walls were then taken down and rebuilt, according to the section given in the drawing.

The bridge unites with the embankment at low water mark, and is 1542 feet in length; it is composed of 47 bays of 30 feet span. The bascule and its piers 80 feet and 52 feet, the space occupied by the piles making the total length of timber work 1542 feet. Its breadth is 22 feet, and height above high water 10 feet, which makes a variation in the length of its piles from 36 to 70 feet; those I have drawn are the two extremes as far as the depth of the piles in the ground, but are shown in 15 feet water.

The timber is of crown brand Memel, selected by one of the contractors who went there for that purpose. The beams were 14 inches square, and

in length from 44 to 90 feet; the specification only required that the piles, caps, and all the larger timber, should be 12 inches square, but the contractors did not reduce it, though they were aware it would have paid very well for its sawing. Mr. Nimmo, in his specification, allowed the piles to be scarfed, which however was not necessary, as long as the selected timber lasted, but from not having imported quite enough, they were obliged to have recourse to this method, not being able to get any of sufficient length in either Cork, Youghal, or Waterfood. The quantity of timber used was nearly as follows:

	Tons.
Hand Railing,	69
Flooring,	220
Joists,	164
Bolsters,	30
Caps,	26
Piles and in breakers,	420
Struts and straining beams,	105
High and low water gauge beams,	60
Diagonal beams,	38
Total number of tons,	1132

The dimensions of the gauge beams, diagonal braces, caps, bolsters, joists, struts, straining beams, purlin beams, and flooring, etc. etc. are given in the large elevations and sections.

The caps are fastened to the heads of the piles by an oaken coke three inches in diameter and six in length, through which an inch and a quarter iron bolt is driven. At each side of the high water gauge beams, there is an iron strap three inches broad and half an inch thick thoroughly bolted. There are also three tailed straps at the joining of the struts and straining beams.

In the specification it was said the piles were to be driven ten feet at least, or until they did not move an inch after receiving twenty blows of an iron ram five cwt. falling ten feet; however, upon driving the piles which formed the first pier, I found that the bottom was so soft, that their own gravity sunk them five or six feet, and that it required very little additional power to drive them the remainder of the ten feet! Upon applying to Mr. Nimmo, he said his idea was, that ten feet would have been enough for the piles to go into the ground, and that it was only in cases where they would not go that depth that he specified otherwise. This circumstance, as well as my observing that the narrowing of the river by building the embankment on the eastern side had caused a washing away of the bottom, induced me to recommend the commissioners to pay an additional sum to the contractors for driving the piles as far as they would go, which proved to be in many instances 25 feet. In cases where the ground was at all hard, the piles were shod with iron, as I have shown.

The quay wall is four feet six at the top, and twenty-six feet high, battering two inches to the foot, with counterforts four by eight, and ten feet apart.

There are two toll houses and about three miles of new road, which comprises all the works connected with this bridge.

The entire length is as follows:

	Feet.
Embankment,	1500
Timber work,	1542
Quay wall,	200
Total,	3242

The expense was under 18,000*l*, but it could not have been done for any thing like that sum, had it not been near one of the finest quarries in Ireland.—*Trans. of the Inst. of Civil Engineers.*

JOHN JONES, C. E.

The following decision of the Superior Court of Connecticut, is copied from the Hartford Courant.

Hooker vs. *New Haven and Northampton Co.*—This was a case involving principles interesting to many corporations, and particularly to persons interested in and affected by the Farmington canal.

The plaintiff brought his action on the case against the defendants, proprietors of the Farmington canal, for damage done to his land by water discharged at sundry times, in great quantities and with great force, from a waste wier of the canal, by which a deep and wide chasm was excavated in his land, and a part of the same rendered inaccessible. The defendants did not deny that the injury had been done by the action of the canal water and in consequence of the manner in which their works had been constructed according to the surveys, as approved by the commissioners.

The defendants claimed a right under their charter to let off all water necessary for the safety of the canal, without any liability for any damages whatever that might be done.

Judge Sherman charged the jury to the effect that there is no redress for such injuries, where a corporation are in the discharge of their appropriate duties; and that if the Canal Co. have done nothing not necessary for the safety and well-being of the canal, they are not liable for any injuries whatever to the property of others, resulting from the acts in question.

The jury thus instructed, brought in a verdict for the defendants.

ELECTRIC TELEGRAPH.—A telegraph worked by electricity is in operation on the great western railway between Drayton and Paddington in England, by which news is conveyed at the rate of two hundred thousand miles per second, or eight thousand times quicker than light travels during the same period. Electrical currents passing through coils of copper wire placed immediately behind some magnetic needles are made to operate upon a circular series of twenty letters, which indicate such terms, either separately or collectively, as they have been arranged to represent. This telegraph will act day and night, in all states of the weather and with such rapidity that one minute only is required for the communication of thirty signals.

SELF ADJUSTING RAILROAD CAR.—A gentleman called on us yesterday with a model of a new railroad car, with six wheels, with the frame so arranged that any curve, say of thirty feet radius, may be turned without friction in the outer rail of the road. The construction of this car is such as to allow a train to pass a curve of three hundred feet radius at the highest speed without injury to car or rails, and without any perceptible friction. The model may be seen at the Franklin Initiute during the present week, and we hope that those who can judge of the merits of such inventions will call and examine for themselves. The Columbia Railroad will afford a very fair trial for cars on this principle.

CLOTH OF GLASS.—Messrs. Williams and Sowerby of London, have been exhibiting, at the Annual Show of the Polytechnic Institution, (London,) their process by which glass first spun by steam power, is woven by the loom into those sumptuous tapestries and rich hangings, which have excited the astonishment of all beholders. This curious manufacture alone is worth a visit to the Institution.—*Atheneum.*

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 9, Vol. V. New Series. NOVEMBER 1, 1840. Whole No. 369. Vol. XI.

ADAPTATION OF THE FORM OF FURNACE TO THE KIND OF FUEL CONSUMED—CONSIDERED PARTICULARLY IN REFERENCE TO STEAM ENGINE BOILERS.

It is surprising to find how little reference has been made in works, professedly written upon steam engines, to a most important branch of the subject—we mean the influence different kinds of fuel have over the arrangement of the furnace and the fire surface of the boiler. The proportion of fire surface necessary to evaporate a given quantity of water and the economical arrangement of this fire surface, are matters fully discussed in such treatises, but the deficiency above named will be found in all.

A sufficient reason for this may be found in the fact that, in England but one kind of fuel is used, and its varieties are so little different from each other that no necessity exists for an investigation. In the United States the case is far different. All sorts of fuel are used, from the most different varieties of wood through the whole range of bituminous coals by imperceptible shades, to the most perfect anthracites. The most indifferent observer cannot fail to remark the variety in the mode of combustion incident to these various kinds of fuel, and the consequent changes to be made in the mode of heating by them. A common, though not altogether accurate rule, is the result of general observation, viz. that the flame should reach the vessel to be heated—but this is very erroneously stated in the ordinary saying that those fuels give most heat which yield most flame.

It might be supposed that the attempts to burn anthracite in the furnaces of steam boilers would have led to useful results. That such has been the case we do not doubt, but the information so gained has never been given to the public in any well digested form, being more frequently made the basis of a patent, which necessarily must become partial and restricted in its application.

Before pointing out the *desiderata* in our knowledge of fuel, it may not be amiss to show how far the information already acquired extends. The

most useful and exact results have been attained by the investigations of Lavoisier, Laplace, Guy Lussac, Berthier, Peclet, Rumford and Marcus Bull. These philosophers have determined with great nicety, the quantity of heat given out in the combustion of various bodies, and although pursueing totally different methods, they have arrived at results somewhat discrepent, yet we have in this very difference the guarantee of the truth of the average of the whole. While the methods have sufficiently determined the *quantity* of heat given out, they in no wise refer to its *intensity* and this is oneof our *desiderata ;* while the former of these must always remain constant it is obvious that the latter, the *intenssty*, varies with the form of furnace as well as the mass of combustible, and is as yet undetermined in the different kinds of fuel. This branch of the subject from the difficulties attendant upon its experimental investigation is yet almost untouched.

The next point to which attention is necessary is the *radiating* power of different combustibles. It is known that all heat is either transmitted by *communication* or thrown off by *radiation*. By the first of these methods the heated gases arising from combustion are made the vehicles for carrying and communicating the heat to those objects against which they are driven—by the latter, the heat from an open grate or fire-place warms a room. The amount of heat distributed by radiation from burnidg bodies, has generally been overlooked as inconsiderable, but Peclet has proved from extensive experiment that it is as much as one-fourth or one-third of the whole heat obtained. Now unless provision is made for intercepting this heat, a large portion of the useful effect of fuel is lost, and as charcoal and bituminous coal as well as anthracite, furnish a greater proportion of radiant heat than wood, unless it is in a large quantity, it follows that different arrangements are necessary. The disposition of parts reqnired to intercept *all* of this heat, would be that of a spherical fire surface entirely surrounded with water, an arrangement in strictness manifestly impossible but to which close approximations can be, and have been made.

Flame also gives out a quantity of heat in the same manner and hence when drawn through winding passages, distributes it both by radiation and conduction. It is on this principle that the tubes in locomotive boilers are advantageous when wood is used—and on the same principle we might doubt their utility when anthracite is burned. We have every reason to believe that the larger the mass of fuel and the greater the intensity of the heat,the greater will be the proportion given out by radiation. This rule will indicate the necessity of a change in the form of furnace, as we in crease our efforts to obtain steam rapidly, as in locomotives.

The heat at which the fuel enters the into combustion, must also be borne in mind, when we vary the form of furnace—and beside this, the temperature at which the smoke, gases and other volatile products burn, is also an important datum. Thus while certain substances require a pluntiful sup. ply of air through large opeuings, and obtain this by the mere draught of the chimney—others require a more concentrated blast and need the aid of

blowers to maintain a vivid combustion. Immediately connected with this is the consideration of the density of fuel and its porosity. Such substances as anthracite having an exceedingly compact structure will require an arrangement totally different from that required by wood. What is sometimes called the second burning, or the combustion of certain gases resulting from an incomplete burning of the fuel, may be turned to profit, or suffered to go to waste and produce serious injury, by the unexpected and dangerous degree of heat communicated to unprotected parts of the vicinity of the boiler. This second combustion may be made to take place immediately over the fuel by introducing air directly into this part of the furnace.

The disposition to form *clinker*, owing to the fusibility of the ashes of some varieties of anthracite, is also a circumstance to be noted and provided for--as by this means the fuel may become united into a solid cake impermeable to air, and the sides of the furnace so coated and roughened by it so as to prevent cleaning without running great risk.

In using anthracite there must be some contrivance for gradually feeding the fuel, and introducing it in a heated state; there are many ways of accomplishing this object without any loss of heat or power

A method which appears to have been successful in the use of hard coal, is to introduce the coal by a hopper placed over or beside the boiler and to have a small aperture at the side to regulate its even disposition over a considerable surface while the boiler is placed quite close to the fuel. The fire in this instance was blown by a fan. The testimonies of all who have used hard coals, unite in insisting upon the necessity of a large extent of burning fuel at no great distance from the boiler surface.

The subject is evidently open for much experiment and consideration. We have not pretended to enter into all its bearings—leaving that to some one better qualified, by the experience of actual trial.

Errata.—Number for October 1st—Lattice Bridges, page 196, 14th line from bottom, a comma after the words "ground," and "braces," 6th line from bottom, "examination" should be "enumeration." Page 197, 1st line, for "supporters" read "supports," 15th line from top, omit the word "ties." Page 198, 6th line from bottom, "insert" should be "invert." Page 200, 16 line from bottom of article, "pins 3 × 12," read "ties 3 × 12."

To the Editors of the American Railroad Journal and Mechanics' Magazine.

Gentlemen:—I notice in the Railroad Journal of September 1st, a statement, that an "eight-wheeled locomotive engine built by Mr. Norris of Philadelphia, left Boston for Worcester, with a load of 150 tons of merchandize, etc.," together with some remarks and conclusions thereon, which leads me to suppose that you and such of your readers as feel an interest in this subject, might be gratified with a more minute detail of the facts connected with that trial.

Having been one of the committee appointed by the Board of Directors for the Western road, to attend to this matter, I can without much incon-

venience to myself give you some of the facts in relation to said trial. The load in question was as follows:—

Plaister, - - - - - -	117	tons	1200 lbs.
80 bales cotton, - - - -	16	"	464 "
325 casks spikes, - - - -	17	"	125 "
	150	"	1789 "
37 cars, - - - - - -	77	"	900 "
Tender full of wood and water, -	12	"	1920 "
Gross load, - - -	241	tons	609 lbs.

2000 lbs. to the ton.

With this load the engine started from Boston about 1 o'clock, P. M., on the 19th of August last. The weather was fair, wind very light, and all the attendent circumstances as favorable for the movement of a heavy load as could be desired.

The first ascending grade was at the rate of 23 ft. per mile, and 1900 ft. in extent; average speed on this grade, about 1200 ft. per minute.

The next upward grade, 13 ft. per mile; extends 5880 ft. On the last part of this grade speed was reduced to about 600 ft. per minute; and on a grade of 29½ and 3800 ft. in extent, speed was reduced to about 576 ft. per minute.

After passing over several miles of level road or light grades, at a speed varying from 1050 to 1344 ft. per minute, the train entered upon a grade of 27 ft. per mile, 3780 ft. in extent; on this grade speed was reduced to 624 ft. per minute.

About 11 miles from Boston, the engine encountered one of the maximum grades of this, (the Boston and Worcester,) road: say 30 ft. to the mile, 13,340 ft. in extent. This plain was entered upon from a descending grade, at a speed of about 1300 ft. per minute; the train proceeded about one mile over that part of the plain, which was straight, or nearly so, gradually reducing speed to about 408 ft. per minute, until entering upon a curve of about 1200 ft. radius, where the engine reached the maximum of her adhesive power. Here the question was settled, not only, that the power of the engine was inadequate to this load on the high grades of the Western road, but that she was overloaded, even for the Worcester road; her power being barely equal to moving the load over the maximum grades of the latter on straight lines, at the rate of about 4 or 4½ miles per hour. By the application of sand upon the rails, an additional amount of adhesive power was borrowed, sufficient to enable her to surmount the inclination, as also, all the other maximum grades of that road, which in the aggregate, amount to about 8 or 9 miles.

The next morning about 10 o'clock, this engine started from Worcester, on the *Western* road, with the same load, together with a small empty passenger car. On entering upon the first ascending grade of 42 ft. per mile, her wheels slipped. The train was then run back, about 1 mile, and again

entered upon this inclination, at greater speed, say about 12 or 1300 ft. per minute. The wheels again slipped, and the load could not be moved forward with all the aid which sand upon the rails could give. Five cars were then detached from the train, the gross weight of which was 30 tons 1835 lbs., reducing the weight of merchandize to 130 tons 1009 lbs—and gross weight of the whole load to about 210 tons. With this load the engine surmounted the summit grade in Charlton, without the use of sand, at the rate of about 4 miles per hour. Her water being out, and her wood nearly so, on the last and hardest part of this grade, I presume that her load was reduced to about 205 tons gross.

On the day following, it was agreed by Mr. Imlay, (Mr. Norris' Agent for these trials,) and myself, that a trial should be made, to ascertain the relative power of this engine, as compared with the Lowell engines, (that being the only kind used upon the Western road,) and as proportioned the weights resting upon their respective drivers.

The weight on the drivers of the Norris engine,	19,220 lbs.
That upon the drivers of the Lowell engine,	16,150 "

The peculiar mode of connection of the engine with the tender, of the Norris engine, together with the position of its cylinders, induced the supposition that when in action, under a full head of steam, there would be a greater *additional* amount of weight thrown upon his drivers, than is usual with an engine acting upon its tender by a horizontal draft. The drivers of these engines were consequently weighed with the application of a full head of steam, (the engine being made fast,) while the driving wheels were upon the scale, and in this state the drivers of the Norris engine weighed 21,070 lbs. Showing an addition to its weight by the steam of 1850 pounds. The lowell engine drivers in this manner weighed 17,155 lbs. addition by steam 1005 lbs. Twenty-seven cars were then attached to the Norris engine, with which she commenced assending the plain near Springfield at the rate of about 7 or 8 miles an hour, and gradually diminished her speed until her adhesive power was overcome having proceeded up the plain about one mile. The train was then run back, six cars detached and the engine started again, with 21 cars, the gross weight of which was 129 tons 1698 lbs., with this load she ascended to the top of this plain in 26 minutes, being at the rate of 5.63 miles per hour.

The Lowell engine then took 17 cars weighing 99 tons 42 lbs. and passed up this grade in 14¾ minutes, rate 9.92 miles per hour. This being something less than a pro rata load for her, and obviously much less than her power was equal to carrying, two more cars were added, increasing her load to 117 tons 218 lbs. With this load she passed up the grade in 21½ minutes, at the rate of 6.8 per hour.

The first 8200 ft. of this plain ascends at the rate of 60 ft. per mile. Next 2000 ft. 66 ft.—then 700 ft. 46;—remainder 60 feet—length of the plain 2.44 miles.

As before stated the weight of the Norris engine drivers, with steam on 21,070 lbs. That of the Lowell, with steam 17,155 lbs.

Gross weight of the Norris engine's load, - -	259,698	lbs.
Tender when full of wood and water 25.950 lbs.; but having stood after weighing 3 or 4 hours, and been run a part of the way up the plain before making this trip, I assume her weight on the drivers at the time of her performance to have been about 3 tons less, leaving - - -	22,920	
Total weight of merchandize, cars and tender, - -	282,618	lbs.

If 21,070 : 282,618 : : 17,155=230,104 lbs.

To make the performance of the Lowell engine exactly equal to that of the Norris, in proportion to weight upon their respective drivers, she should have taken up 230,104 lbs., in 26 minutes.

Gross weight of the 19 cars she did take up, - -	234,418	lbs.
Tender 14,000, less for loss of wood and water 2,000 lbs.	12,000	
	246,418	
	230,104	
Difference,	16,314	lbs.

Lowell engine 4 wheels, 2 drivers, $4\frac{1}{2}$ ft. diameter, 12 inch cylinder, 18 inch stroke, steam pressure in the boiler 90.

Norris engine 8 wheels, 4 drivers, 4 ft. diameter, $12\frac{1}{2}$ inch cylinder, 20 incher stroke, steam pressure 130.

Yours, etc.,

WILLIAM JACKSON.

Newton, Mass. Oct. 8th, 1840.

REPORT OF JAMES RENWICK, LL.D., ON MODE OF SUPPLYING THE ERIE CANAL WITH WATER FROM LOCKPORT TO THE CAYUGA MARSHES.

(Continued from page 238.)

(1) In order that the water which descends at Lockport into the Rochester level shall not be backed up, and prevented from flowing forward to supply the levels beneath, it will be necessary that it should have a free course through the aqueduct at Rochester. The arrangements proposed by the engineers in the plan of the enlarged canal will be of use in effecting this object. These are to lower the bottom of the canal immediately on leaving the aqueduct, one foot; to give the bed of the canal between the aqueduct and the first lock a slope of an inch to the mile; and further to incline the bed near the lock until the depth be increased a foot. It will be in addition necessary to guard against any injudicious use of the waters of the Genessee river. It is obvious from the facts heretofore cited, that whenever water is introduced thence, in such abundance as to raise the canal, to the east of the aqueduct, above its normal depth, it then becomes necessary to draw all the supply of the eastern division from the river, and that a small additional increase in the depth may cause a current westward. The gate of the first lock therefore, instead of being raised four inches above the proposed surface of the canal, ought to be at that level, or

even at a small depth beneath it; and a weir ought to be provided of sufficient extent to pass down the water required beneath, without the necessity of any rise in the level of the surface in the aqueduct. Any injudicious use of the feeder ought to be counteracted, along with flushes arising from a frequent use of the lock by which vessels pass from the river into the feeder, by a regulating waste wier, so placed as to return all excess of water immediately to the channel of the river. Great stress is laid on these points inasmuch as error in either structure or management, in this part of the canal will effectually defeat every provision which may be made in other parts for drawing the whole supply from Lake Erie.

2. The changes which it is proposed by the engineers to make in the enlargement of the canal, between Black Rock and Lockport, seem to ensure that a sufficient quantity of water shall always reach the head of the system of locks. No modification or change of this part of the plan would appear to be required. It is otherwise with the long level which extends from the foot of the locks at Lockport to the first lock east of Rochester, a distance of 64 miles. In respect to this, two different opinions are entertained, the one urges a general increase in the slope of the bed of the canal up to an inch or even $1\frac{1}{16}$ in. per mile. The other, admitting a small increase in the slope which can be easily attained, proposes to compensate for want of slope by an increase in the dimensions of the canal. The latter plan divides itself into two distinct propositions. In the one it is proposed to maintain a constant depth in the canal. The other is founded on the plan of making the depth diminish in accordance with the expenditure of water in leakage &c. By the latter method an increase will be gained in the slope of the surface of the canal, and we shall see that it is possible so to unite and modify the two propositions of the second plan, as to give the canal all the advantages to be derived from the first. There is a fixed point in the bed of the canal which must control all the changes which are to be made in its structure. This is the floor of the aqueduct at Rochester. By the aid of much exertion and expensive excavation in rock, it has been found practicable to lower this one foot beneath the bottom of the present aqueduct. It is too late to enquire whether it might not have been possible by the use of iron as the material for the aqueduct instead of stone, to have lowered the channel still further. The slope of the bed of the canal is at present $\frac{1}{2}$ inch to the mile, and from the foot of the locks at Lockport to the first lock east of that place is 32 inches in a distance of 64 miles. Sinking the aqueduct 12 inches gives a slope of 44 inches, or 0.6875 inch per mile. The plan of deepening the canal to the east of the Rochester aqueduct, and increasing the slope of its bed to the first lock has already been referred to but it is not necessary that this change should enter into the question at present under consideration.

It is proposed, and the proposition appears to have been adopted, to make the depth of the canal in the city of Rochester seven feet. It may therefore stand 9 feet deep at the first lock, and will then allow of a depression of

two feet. Mr. Barrett advises that the depth of the canal at Lockport be made 8 feet. Adding this additional depth to the slope of the bed we have 56 inches or $\frac{7}{8}$ths of an inch per mile, for the slope of the surface from Lockport to Rochester.

It will be expedient in addition, to maintain the canal at the constant depth of 8 feet for seventeen miles to the eastwards of Lockport. This will be rendered easy and advisable in consequence of the possibility of introducing a feeder into the canal at this place through the valley of the Oak Orchard Creek. This feeder commands the waters of that stream and the Tonnewanda. It has by an accurate guage been determined that they are capable of furnishing in the driest seasons 1400 cubic feet per minute. On the course of this feeder it is reported that a reservoir might be formed of 1000 acres, which can be filled from the Tonnewanda.

It is therefore proposed that the canal be carried forward from Lockport as far as the Oak Orchard feeder with a slope in both bottom and bank of 0.6875 inches per mile, being the same that it has been seen will be practicable along the whole line of bed. At this point it is proposed that the depth of water shall begin to decrease, and shall continue so to do until it attain a depth of seven feet.

The rate at which water flows in a given channel depends upon the slope of its surface, and not on that of its bed. We have therefore to add in this case to the regular slope of the bed of 0.6875 per mile, the foot gained by diminishing the depth from 8 ft. to 7 ft. This will give in the remaining 47 miles a superficial inclination of 44.3 in. or very nearly one inch per mile. In this way then nearly as great a slope as has been considered necessary by either engineer may be attained.

It remains to be inquired what dimensions shall be given to the transverse sections of the canal, which when taken in connection with these depths, constant for 17 miles, and these diminishing from 8 ft to 7 ft, will suffice for the flow of the requisite quantity of water.

Mr. Barrett has calculated with great labour and care several tables of the dimensions of the canal upon different hypothesis of depth and slope. The basis on which two of these rest are sufficiently near the circumstances of the mode we propose to permit the use of the dimensions thus calculated. The first of these is adapted to the constant depth of 8 ft, and from it the dimensions for the first seventeen miles to the eastward of Lockport may be taken in the nearest round numbers. These would give for the surface breadth of the canal at Lockport 93 feet, and a diminution thence at the rate of 6 in. per mile until at the end of the seventeenth mile it becomes $84\frac{1}{2}$ ft.

By the second table of Mr. Barrett it would appear that a canal of decreasing depth losing 200 cubic feet per mile per minute would diminish from the latter dimension to a breadth of 70 ft and depth of 7 feet in the space of 31 miles. It would not however do to permit the dimensions to diminish thus rapidly, for the canal, if continued of uniform dimension for

the remaining sixteen miles and losing, as estimated, 200 cubic feet per mile per minute, could not be maintained of a constant depth. It is therefore proposed that the diminution in the dimensions of the canal, until it enter the city of Rochester, when its figure is to be altered, should be regular. Taking this distance at 43½ miles, the diminution in the surface breadth of the canal will be at the rate of 4 in. per mile. The decrease in depth between the junction of the Oak orchard feeder and the entrance of the Rochester aqueduct will be 12 inches, or somewhat more than ¼ in. per mile.

Were recourse had to strict mathematical calculation, it would be found that the canal from Lockport to the Oak Orchard feeder having the dimensions proposed will pass more water than is exhibited in the tables of Mr. Barrett, in consequence of the inclination being a little greater than he has assumed. So also similar calculations would show a demand on the Oak Orchard feeder of about 2000 cubic feet per minute in order to meet the increased rapidity of the current. This demand will not however occur in practice, as the change in the slope of the surface will take place insensibly and there will be in general a flush of water at the foot of the locks at Lockport. In the use of the Oak Orchard feeder, therefore, it will be necessary to observe precautions of a similar character to those which have been pointed out in the case of the Genesee feeder. Thus the feeder ought not to be used except when the canal falls below its normal depth of 8 ft, at the place of junction, and should not be kept open after the depth had again reached that limit.

The whole line thus proposed if strictly calculated will show an excess of water running in it. This is necessary as a precaution, and can be productive of no inconvenience in practice Should the supply be over abundant, it will only be necessary to allow the depth of water at Lockport to subside, and the defeat will be remedied. It is however believed that the quantity which will actually flow in the canal cannot hold out with the calculation, and that the provision for an apparent excess is wise and necessary, obstructions which cannot be allowed for in any calculaton exist, and taking those which have been stated, in connection with the curvature of the line of the canal, there would appear to be no danger of the current exceeding ½ mile per hour.

Such a current, or one more rapid, is not to be objected to, under the circumstances of the case. The great amount of freight is a descending trade. The boats which pass downwards heavily laden, return almost empty, and thus a current from Lockport towards Rochester, so far from being objectionable, must be a great facility to the trade of the canal. Had the canal been to construct anew, and been independent of the interests on its banks, a greater slope than one of an inch to the mile would have been recommended. The canal is in fact under circumstances which entitle it to be considered until it reaches Rochester, rather as a navigable feeder than as a mere navigation. We might therefore have had recourse to the

instances of such works as have been erected in Europe, for the double purpose of navigation and conveying water. Of these we may cite that of the canal del'Ourcy. the slope of whose beds is more than 6 inches per mile, and which is notwithstanding easily navigable in either direction. The navigable feeder of the Union canal in Pennsylvania has a slope of four tenths of a foot per mile, and there are instances where navigable channels have had even greater inclinations.

3. The water, in entering the aqueduct at Rochester will be much less retarded than it now is. The area of the new aqueduct will bear a greater proportion to that of the canal than at present, and the abrupt angle at the eastern end will be much improved. Still, an allowance ought to be made for this obstruction, which may be estimated as equivalent to a fall of two inches. No water therefore ought to be permitted to flow from the Genesee feeder until the depth of that at the eastern end of the aqueduct fall below six feet ten inches.

4. It has been proposed to place a guard lock at a short distance to the west of Rochester, for the purpose of forming a reservoir of water in the bed of the canal itself. There is no valuable object, as far as can be perceived, to be gained by this. The water is not needed in the Rochester level, but is required for the supply of those beneath. All that can be sent forward will often be demanded for this purpose, and when there is any surplus it ought not to be retained in the Rochester level, but if possible in a reservoir fed by it, and capable of being drawn upon by those below. The introduction of such a gate will enhance the greatest of the existing evils, namely, the discharge of water which is actually wanted at lower points over waste gates near the points where it enters the canal.

It may be here stated that there is a possibility of increasing the slope from Lockport a few inches by adopting the asphaltic mastic, as a lining for the aqueduct. This has very important advantages, and may at the present moment be obtained at a very low rate.

5. It appears to be in contemplation to establish stop-gates at various places along the line of the canal. These will, it is presumed, be similar in their structure and adjuncts to the upper gate of a lock. The canal will therefore, at these points, be diminished to less than half its ordinary area. In introducing these gates, it must be considered that when a contraction in a stream takes place, it acts as as a bar, to accumulate the water above it, until the slope of the surface becomes sufficient to discharge all which has accumulated; it will therefore be necessary to allow at the entrace of each stop-gate such slope as will not retard the current above them; within their walls such a slope must be admitted as will cause an increase in the velocity of the current adequate to pass the quantity which flows in the full width of the canal, through the narrow space.

Unless an extra slope be allowed in such places, either the canal will not run full, or, if full, the quantity which flows will be governed by the area of the stop-gates, not by that of the rest of the canal. It appears pro-

bable, that at least, four such gates will be considered necessary between Lockport and Rochester, and a fall of at least an inch in the bed of the canal ought to be made at each of them over and above what has already been stated as proper and necessary.

6. The slope of the surface of the canal will be regulated by the lock gate and discharging weir east of Rochester, and by the level at which the edges of the waste gates are maintained. The depression of the former has already been recommended in order that the water in the long level may flow regularly forward without obstruction. The lateral waste weirs ought to be raised of solid and permanent materials up to that level at which it is intended to keep the water of the canal, and the arrangements cannot be considered as perfect until it shall appear that no water runs to mere waste. When water is scarce it may be expedient to raise the waste weirs some higher by means of plank, in order that there may be no loss by the overflow of waves. The discharging weir at the lock east of Rochester, ought to be sunk so low that the quantity necessary to supply the leakage and evaporation of the lower levels shall be certainly passed over it, without the necessity of raising the surface of the water in its neighborhood.

7. At this lock, and at the four which next succeed it to the east, the plan of obtaining baisins of considerable breadth at the head of each lock, for the purpose of meeting the demand of an unusually rapid lockage, as proposed by Judge Roberts, will be attended with much benefit.

8. An extension of the canal in width at Lockport, even beyond the limits heretofore assigned, so that the water passed through the locks may have room to expand itself, until it shall set the water below it in motion, will be also advantageous. It is obvious that the double system of combined locks must pass twice as much water into the lower level as a single lock carrying the same trade, would, and it is farther clear, that a single isolated lock might pass as many vessels in a day, as the double system when combined. On this is founded a suggestion for equalizing the flow of the water after it has passed the locks at Lockport. Place a guard gate at the point where the embankment on the north side of the canal commences, the surface of whose gates shall be level with that of the gates of the lower lock of the system. This gate will pass as many vessels, in a given time as the combined system, but will use in lockage no more than half the quantity of water. During a time when a great number of boats are passing, half the water may accumulate in this basin formed between the lower lock of the system and this guard lock to be discharged where the lockage is less frequent. Even below this point it will be well to give to the canal all the breadth that it can conveniently assume. and the waste weir at Lockport ought to be closed altogether. At present there is no waste weir from that at Lockport, for nine miles to the east. One which is favorably situated about six miles to the east, has been closed and has gone out of use. I should propose that it be refitted and reopened. It will

be quite near enough to prevent the water accumulating to a dangerous extent after passing the locks at Lockport, and yet so distant as not to be affected by waves or sudden and temporary flushes. Indeed, I cannot but consider the closing of the waste weir at Lockport by an embankment as all important to the assurance of being able to feed the canal east of Rochester without drawing upon the water of the Genesee river in seasons of drought.

Among the objections usually made to the double system of combined locks, is the quantity of water they require for lockage. Such, however, is the demand for water on the lower levels that all which is passed through them might be of service. In times however, when the passage of boats through the locks is frequent, the water discharged from them in large quantities, forms a wave, and does not, for an appreciable interval cause any motion in the canal below. The flushes of water arising from frequent lockage are therefore principally discharged at the nearest waste weir. This discharge ought, at all events, to be rendered as small as possible, and waste weirs ought to be no more frequent than is absolutely necessary to preserve the canal from risk of break.

9. Were the canal to be laid out anew, it would be best to seek for a new route from Lockport, eastward, so chosen that the locks which are now combined in Lockport might be distributed at distances as nearly equal as possible. The interests which have been created by the canal in its present route are of such importance as to forbid any changes, except such as are slight, in the line of the canal. Lockport itself owes much of its present importance, and all which is hoped for it in future, to its position at the point where so great a fall is accumulated. If in the arrangements which are necessary to feed the canal from Lockport to the Cayuga marshes, inconvenience may arise to the towns and villages on its banks; it might be well for their inhabitants to consider whether such inconveniences had not better be patiently submitted to, than a complete change in the route of the canal, which every other interest except that of their local property seems to demand.

10. It is proposed by the engineers to line the bottom of the canal whereever it is cut to the rock, and to puddle its banks. This will be efficient in preventing any excessve leakage. It is also proposed to increase the slope of the banks from $1\frac{1}{2} : 1$ to $2 : 1$. This will remedy to some extent, the filling up of the canal by a change in the figure of its section, growing out of the looseness of the material. The finishing of the counter-bank of the canal is of equal or even superior importance. Whenever this is formed by a cut or by an embankment, and not by the mere spreading of the water until it is confined by natural surface of rising grounds, there ought to be a *berm* or shelf on a level with the surface of the water. This berm should be from 18 in. to 2 feet in breadth, and should be sown with aquatic plants or covered with sod from marshes. The counter-bank itself should be formed with as much precision as the towing path,

although it will only require the neighboring earth as a material, and its slope to the berm ought to be sodded or sown with grass seed. The top of the bank should slope from the canal towards a counter-ditch by which the surface water of the country may be intercepted and carried forward to a proper place of discharge under the canal. In deep cuts the earth should rise from this ditch at a slope which it is capable of maintaining and should be sodded or sown with grass seed. On the tow-path side, a similar berm, covered with chip stone or course gravel, ought to be formed, and except on side lying ground, a counter-ditch, to intercept surface waters, ought to be cut. A great improvement has already been made in the towing-path by making it highest on the side nearest the canal.

11. The canal being fed with pure and clear water from lake Erie, the slope of its sides being made such that the earth can sustain itself; the caving in of the bank prevented by finishing it as carefully as the towing-path, and providing both with a berm; the dropping of earth from deep cuts, and the wash of the surface waters being excluded, there would seem to be no reason why the canal should have its area diminished beyond what might from time to time be washed out, by opening waste gates during seasons of flood, or of inactivity in the trade. There would remain the obstruction of the aquatic weeds. For these there is probably no other remedy but to keep them closely cut, although it might be worth the trial whether salt or costic lime might not effect their destruction at an expense less than the labor of cutting them.

12. Admitting that the canal constructed upon the principles which have been stated, from Lockport to Rochester, will convey to the lock east of the latter place all the water which may be required to feed it thence to the Cayuga level, it is, notwithstandiug, certain that the draught through the locks may be, in some cases, so rapid as not to be identically supplied without delay. In seasons of excessive drought, or in case of breaches in the canal, the calculated quantity of water may not come forward as wanted. For these and various other reasons, a reservoir of large extent in the vicinity of Rochester, would be desirable. It would probably be practicable to construct this in the bed of the Genesee itself, or that of any of its tributaries. There is, however, on the right bank of the Genesee in the neighborhood of Rochester, an opportunity of constructing a reservoir with great facility. The canal, after proceeding on a level for a mile and three-eights, to the east of Rochester, begins to descend. The descent is effected by five locks having an aggregate fall of thirty-seven feet, within a distance of a mile and three quarters. For this distance the canal skirts a slope which extends gradually to the north-east. It is obvious to the most superficial inspection that a level line might be run to the north at a depth of thirty-seven feet below the surface of the water in the higher level of the canal, which would include a very large extent of ground. Any portion of this ground might, if surrounded by an embankment, receive water from the canal on the Rochester level, or from the Genesee river, at times of

flood. This might, in case of need, be drawn from it into the Pittsford level, and thence into those further to the east. A careful survey would be necessary to determine the best position for such a reservoir, in reference to the cost of land and convenience of filling and discharging it. A reservoir of a square mile or upwards might be readily marked out, and by forming the embankment of earth excavated from within the selected space it might be made to admit of an average drought of twenty-five feet of water, or even more. A reservoir thus formed, by embanking a level portion of ground on the margin of a stream, has great advantages in point of security from accident by flood, of ease of construction and probably even in cost, over those which are formed by dams across the channel of a stream. This reservoir according to the opinion of those best acquainted with the Genesee river, might be filled from it as late as the month of June, without interfering with the mills, and a considerable surplus may, whenever the trade is not brisk, be drawn from Lake Erie by the canal itself. As the trade is least active in the month of August, and does not begin to revive until September, there seems to be little doubt that the reservoir might be maintained full until the beginning of the driest season of the year, and if of sufficient size would not be exhausted before the setting in of the autumnal rains.

The construction of such a reservoir, if not sufficient of itself to insure the supply of she canal to the east of Rochester, must tend, in a very great degree to compensate for the difficulties which, under the most favorable views that can be taken ol the case must attend the supply of the canal for the entire distance of 122 miles from Lockport. A reservoir on the Valley of the Oak orchard creek, receiving water from the Tonawanda has been spoken of as essential to one part of the plan of canal.

According to the report of Mr. Barrett this may be made to include a thousand acres, and the streams, besides a great surplus in times of flood, furnish in the greatest droughts 1400 cubic feet per minute. It is also stated by Mr. Barnett that another reservoir of about 200 acres might be constructed on a stream which is sufficient to replenish it,

13. The dimensions which it is proposed to give to the canal at Rochester are larger than are absolutely necessary for a canal whose locks have a breadth of 16 feet. The breadth at bottom might be reduced to 32 feet, and that at top to 60 feet, without becoming unfit for the purposes of an easy navigation. It might therefore be expedient to give to the surface of the canal from Pittsford to Lockville, a distance of 25 miles, a breadth at the surface of 65 feet; and from the latter place to the Cayuga marshes, a breadth of no more than 60 feet. The latter breadth is as great in proportion to the width of the lock gates as is given in the practice of European engineers. It would appear to be expedient to give the longer levels a slight slope, say half an inch per mile. In the shorter levels, the flushes arising from lockage will give a sufficient velocity.

In order to insure that the canal may be fed from lake Erie to the

Cayuga level, probably by water from the lake, and certainly without the necessity of drawing upon the Genesee river in times of drought, it will appear from what has been stated that certain plans are important and absolutely necessary.

In conclusion, it will appear that the measures proposing for attaining the object of feeding the Erie canal from the lake, may be divided into two classes, one of which has reference to the management of the canal, the other to its structure. In respect to management, the most important points are, that the grass which grows in such quantities at the western extremity of the canal should be cut or destroyed, that the water which enters the Rochester level at Lockport in waves and flushes shall be retained in the canal until it has set the body of water in motion, and that if it should be absolutely necessary, although it is hoped there will be but rarely need, to introduce water from the Genesee river, it should be done in such quantity as will not raise the level, and thus interrupt the flow of water from Lockport.

Among the changes in the structure it is proposed, after attaining as great a degree of slope for the bed of the canal as can be reached without material injury to the towns on the route, to insure the conveyance of the quantity of water estimated to be necessary, by giving to the cross section of the canal, large dimensions in the neighborhood of Lockport, and lessening them in proportion to the expenditure of water on the way; to accelerate the flow after the last supply of water is admitted, by making a gradual diminution in the depth and thus increasing the slope of the surface, to prevent the filling in of earth and the filling up of the angles of the bed by amendments in the shape of the section, and the introduction of berms and counter-ditches; finally, as one of the most important features, it is proposed to bring in the aid of reservoirs intermediate between lake Erie and the Cayuga level. Of these, the one most essential to the regular working of the canal should be placed on the east bank of the Genesee at Rochester.

JAMES RENWICK.

We conclude in this number the report of Prof. Renwick, which was made at the request of the citizens of Rochester. Although a matter of apparently local interest, its immediate connection with the question of enlargement, cannot fail to give it interest. We believe the other reports on the same subject have not yet been published.

By an oversight, the article in our last number on Compressed Peat, did not receive credit as having been taken from the "American Repertory."

Owing to circumstances beyond our control, the last number of the Journal was not out on the day of publication. A recurrence of this will be prevented and the numbers punctually delivered when due.

New apparatus for heating blast for furnaces.—Mr. Lyman is engaged in constructing a new apparatus for heating the blast at his furnace, on the island, which we are assured, if it succeeds, (and the inventor has no doubt of it,) will be far superior to any thing of the kind now in use in this country or in Europe. Its superiority consists in always keeping the blast heated to a proper degree, increase of quantity, its application, and its economy, producing a saving of at least *one dollar* in the hot blast on every ton of iron made. As soon as it is tried we will furnish our readers with a more particular description.—*Miner's Journal.*

Unprecedented Despatch.—As an instance of the hitherto unequalled rapidity of communication between England and the United States, may be mentioned the circumstance that boys were sellling in our streets, on Saturday *morning* last, London papers of Saturday *evening*, Oct. 3d, received *via Liverpool*, being less than fourteen days from the time they were issued from the London press.—*Bost. Trans.*

Steam.—Lieutenant Janvier, of the French Navy is said to have discovered the means of getting up the steam of engines with such rapidity, that in ten minutes from the first lighting of the fire, and although the water in the boiler be quite cold, a vessel may be set in motion. This is, it is added, to be accomplished without any additional apparatus, and very little expense.

The receipts of the Liverpool and Manchester Railroad for the last six months amounted to 126,474*l*; the expenses to 67,003*l*, and the net profits to 59,471*l*. There was a previous surplus of 10,784*l*. A dividend of 5 per cent. was declared, amounting to 60,445*l*, leaving a balance of 9,809*l* to the to the credit of the next half-yearly account.

ON THE STEAM-ENGINE.

(Continued from p. 215.)

Having in our former papers ascertained the true constitution of steam, we shall henceforward be enabled to apply it in the best manner to produce motive power, as it evidently ought to be applied: comparing and correctly distinguishing its effects within the different kinds of engines in which it has been usually employed, namely, *low-pressure engines*, or those in which the piston is uniformly impelled the whole stroke by steam little exceeding in density the atmosphere, while resistance is removed from the opposite side of the piston by condensation of the steam; *high-pressure engines*, or those where the piston is driven with a uniform force the whole stroke, by steam of much greater density than the atmosphere, the opposite side of the piston being relieved by the steam escaping without condensation; and *expensive engines*, or those in which the piston is impelled some distinct part of the stroke by expanding steam alone.

If we thus far extend our views, the general and proportional efficiency of steam within engines will be fully exhibited, and the best method of applying it will thence become so very apparent, that the methods commonly preferred and practiced will appear in general as strangely erroneous as they are alike extensively and deeply injurious to many important and increasing interests.

If in a high-pressure engine, (which we shall denominate A for the sake of future reference) we employ steam of the density of four atmospheres, or with a pressure of 60 lbs. per square inch, its effective force upon the piston will be three atmospheres only; because the steam, in its exit from the cylinder, re-acts against the piston with a force of one atmosphere:

hence the effective pressure of the steam is reduced to 45 lbs. per square inch.

If in a low-pressure engine, (which we shall call B) we employ steam of the density of one atmosphere, or with a pressure of 15 lbs. per square inch, the same absolute quantities of water and heat that were employed to form steam of 60 lbs. per square inch in the preceding high-pressure engine, will supply a low-pressure engine of four times the capacity with steam of 15 lbs. per square inch; and as the piston will be resisted by the reaction of steam of about 1 lb. per square inch in the vacuum so called, the actual effective preesure of the steam is reduced to 14 lbs. per square inch; but as the area of the piston is four times as large as in the high-pressure engine, so the effective force of the steam upon it is as proportionally greater as 56 to 45; and the low-pressure engine would be of course the most powerful in that proportion, were it not that in a low-pressure engine an allowance must be made for an additional load upon the engine, resulting in the power employed in working the air and hot-water eduction pump, and in working the cold-water pump. For this reason, the aforesaid balance in favor of B will be varied with local circumstances, and be considerably reduced in large engines, while in small ones it may be annihilated.

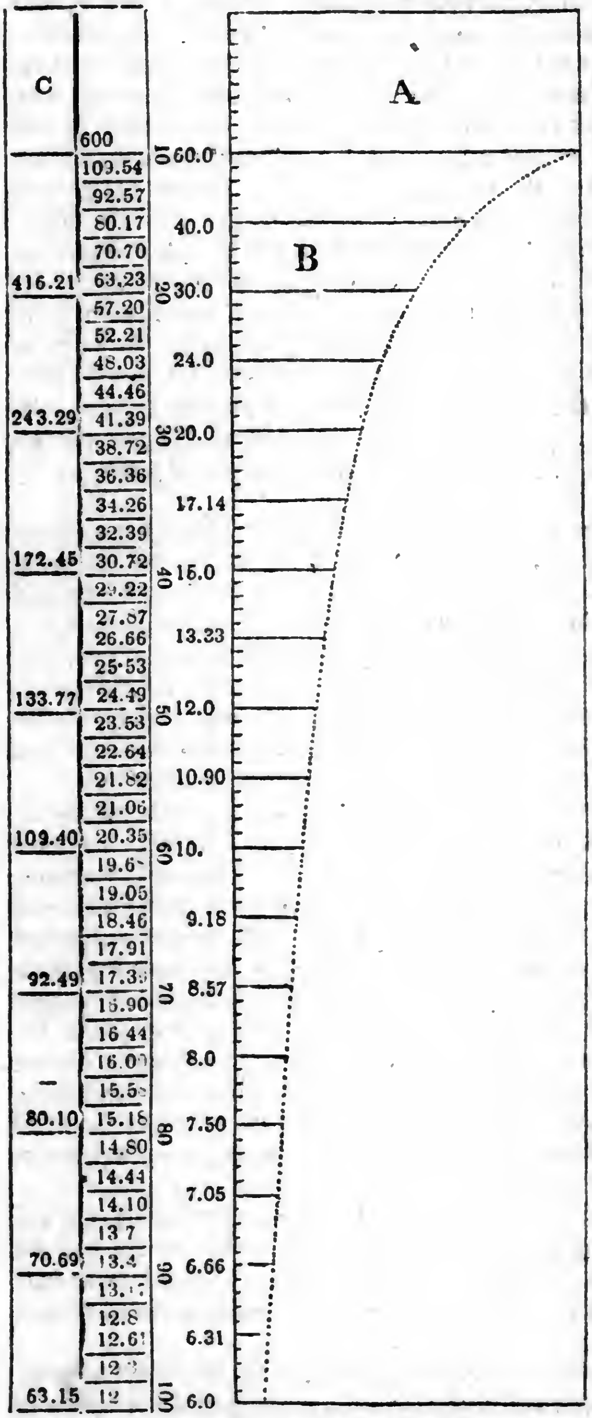
Hence, then, it is oftentimes a nice matter to discover which description of engine, A or B, will perform the most work with the same value of steam; and again we see what time has been wasted in discussions and fruitless disputations as to which is the more powerful engine of the two; and how much more advantageous it would have been for mankind, had the talents and leisure of the disputants been employed in extending or perfecting the improvements in both, rather than in pertinaciously claiming unwarranted superiority for either; nourishing useless and pernicious prejudices; neglecting reason, the light of science, and good example.

How far a neglect of these has been injurious will be apparent, if we observe that high steam, when expanded, is not lost, but merely becomes low steam; and that low steam, propelled from high-pressure engines, though so generally and carelessly wasted, still remains as powerful and as valuable as was the high steam employed, were it but properly applied in a suitable engine. It is evident from this that steam which has propelled any high-pressure engine, as A, may be just as advantageously again employed to propel one of low-pressure, as B; equal in power to A, because the area of B may always be so proportioned to the density of the steam in A as to secure its full efficiency. Hence, again, the converse follows: the steam required for a low-pressure engine may be generated of greater density, and first used to propel a high-pressure engine previous to its employment in one of low-pressure.

Now, as steam can be practically employed twice in succession, should we choose, it can thus be always doubled in value, for two results can be obtained with one expense, and a great economy be thus effected wherever a sufficient supply of cold water can be obtained for condensation of steam, when again employed in a low-pressure engine.

What a complete contradiction is produced by this valuable result to overthrow all Mr. Palmer's assertions! showing, as it does, that the powers of all existing low-pressure and high-pressure engines may be doubled without expense, his very great authority against it notwithstanding. What a splendid lesson does it furnish to the confused, dull and tiresome advocates of the present ineffective low or high-pressure engines, in which the mere successive employment of steam alone is here undeniably shown to produce, in the joint use of those engines, double the power that can be produced by

them if but singly employed as at present, and which employment is so advocated and so lauded, and in such a haughty tone of defiance, by Mr. Palmer, as perfectly unsurpassable!



The actual power to be gained by the expansion of steam within a heated cylinder, maintained at a constant temperature, is shown in the annexed diagram and table, wherein the space A represents the quantity of high steam expanded; the space B, inclosed and bounded by the parabolic curve represents the proportional additional power gained by the expansion of the steam in A, through the respective portions of B, in which the ordinates represent the decreased density of the expanded steam, corresponding with and consequent upon its expansion.

The table C shows the calculated value of each area of the fifth of a volume of the high steam employed, and represents the actual gain, which may be thus ascertained by inspection.

For example: Assuming the value of the high steam as 600, and when an equal volume of the steam has been cut off, as at half stroke, the gain is 401.23; when cut off at one-third stroke, the gain is 659.50; and so tabulated for any portion, to one-tenth of the stroke.

In the diagram, the high steam admitted to be expanded is assumed of the density of 60 pounds per square inch; but the proportional gain, by the expansion of steam of any other density, may be obtained from the table by simple proportion, because the expansive value of steam is a constant proportional quantity. Thus: If the value of steam of 85 lbs. per sq. inch be required when twice expanded; then, as 60 lbs. is to the tabular value of 659.50, so is 85 lbs. to 93.44 × 85 = 178.44; the value required.

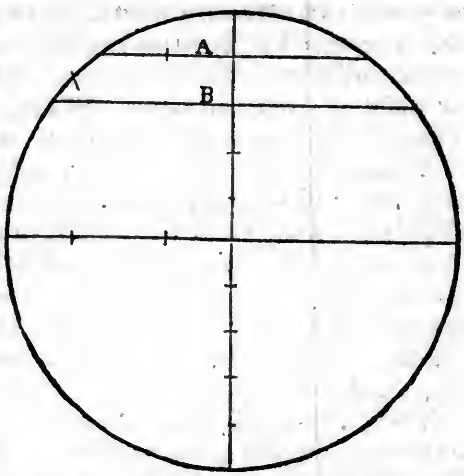
Again: the average steam pressure of any area of the table C may also

be easily and correctly found, by dividing the sum of the area whose average is sought by the parts included in the centisimal scale of the diagram within the area. Thus, the sum of the area of steam of 60 lbs per inch, cut off at one-sixth stroke, is 1674.67, and divided by 60 parts, the sum 27.9 is the average steam pressure of the section sought.

Again: the average pressure of incipient steam of any other density may be found by proportion, from the previous process. Thus, as 60 is to 27.9, previously found, so is 43.25 to 20.11, the true value of incipient steam of 43.25, cut off at one-sixth stroke, though given in Mr. Wickstead's communication, in the 2d vol. Trans. Inst. Civil Engineers, as 17.66 only, and which erroneous calculation affects his description of the value of a Cornish engine in no inconsiderable degree, as we shall more particularly state in a future notice of that paper.

Having thus ascertained the true proportional value of expanded steam, we perceive what a great accession of power may seemingly be thus obtained without expense, and as it really may be, to a very great extent, in the pumping engine; because steam, however much expanded therein, provided its elasticity still continues to exert a greater force than all the friction of the engine and of the pumping machinery united, the motive power of the steam still remains available, which in this kind of engine is appended to one end of a lever beam, from the opposite end of which the load is suspended. Any power thus applied acts with its full effect at all parts of the stroke, as the load is always reacting with a uniform leverage, just as a weight in one scale acts on the weight in the opposite scale of a common balance: hence, the full effect of steam decreasing in intensity is limited alone by the friction of the engine and machinery. But in rotary or crank engines, a much earlier limit obtains, from the nature of the crank itself, combined with the rapid decrease of the expanding force of steam; and this limit has been found of so much actual consequence in these engines as to have caused many engineers to hazard the assertion that the expansive force of steam could not be advantageously employed therein. And the assertion is not made without some show of reason; because this expansive force cannot be practically employed to either the same extent or to the same advantage, in rotary as in pumping engines; yet as it can be employed in them to a highly useful extent, it is very desirable and very important also, to ascertain with some tolerable precision what that extent actually is.

We shall now endeavor to show by the annexed diagram, with the aid of our former one, why the power of expanding steam cannot be employed as effectively in rotary as in pumping engines, and what degree of power can be obtained in the former; and though our proofs, to be practical and popular, will not be strictly precise, yet they will be sufficiently so for the sole purpose for which they are here produced, to explain the useful and important facts under immediate consideration.



Let the path of the crank pin be represented by the circle in the diagram, and the descent of the steam-piston by the perpendicular diameter divided into 10 equal parts. Let us now suppose high steam admitted on the piston, to be cut off at a small part of the stroke, as recommended by non-practical theoretic writers.—We assume one-tenth of the stroke, in accordance with such recommendations, and as conveniently affording chords of whole numbers.

Now, the load of a paddle-wheel, or of any other machinery driven by a crank engine, being constant, may be represented by the radius of the circle=5; and during the descent of the piston through one-tenth of the stroke, the average effective leverage of the crank has been just half that of the semichord A=3; hence, the effective leverage of the crank has been, during this portion of the stroke,=1.5, or three-tenths of the radius only; it is evident the value of this, the most effective part of the motive power, the force of the unexpanded high steam, is reduced in the ratio of 10 to 3.

The semichord B being=4, during the descent of the piston the next one-tenth part of the stroke, it is evident the leverage of the expanding steam is as 3.5 to 5.0=the radius; and the value of this, the most effective portion of the expanding steam, is reduced in the proportion of 10 to 7.

In this great loss of power, or little effect from the small leverage of the upper portion of the crank during the rapid expenditure of the most effective portion of the steam, exhibited in the upper part of the diagram and parabolic curve, we may perceive sufficient cause for the great difference that is found between practice and the assumptions of theoretical writers.

We shall now attempt an explanation of facts, as fully as we can, as we shall at a future period find it exceedingly essential, and involving consequences of the first importance in our view of the future and full improvement of the steam-engine. Our observations on this particular subject are deduced from the long by-gone experience of more than twelve years, in working a powerful condensing, double-acting crank engine, impelled by expansive high steam, and constructed on purpose to test, and in hope of realizing, our expectations and views, which in a great measure resembled those now or recently held by Professor Renwick; as well as other essential improvements of the steam-engine, which will be fully explained hereafter, as they have proved of singular utility in steam navigation, and will contribute much to the future general improvement of the steam-engine. The engine, and machinery attached to it, afforded the fullest opportunity for correctly investigating the amount of work done at different times and under different circumstances.

For a considerable period, the high steam was cut off by different timed movements of the slide, effected by cam wheels, closing the induction steam passages completely, at one half, one-third, one-fourth, one-fifth of the stroke, the eduction passages for steam being open nearly the whole stroke; when it soon appeared that one-fifth was useless, one-half and one-fourth each much less useful than one-third, which was very superior to all others, and very effective.

Subsequently the slide was operated the whole stroke, by a common ec-

centric movement, and the high steam cut off by a small expansion valve; and again in these altered circumstances, as far as could ever be observed in numerous trials, the maximum effect of the steam producing the greatest efficiency of engine was obtained by cutting off the steam at one-third the stroke. Now, in both cases the really true internal abscission, had an indicator been applied to test it, was probably a little earlier than one-third; and as the motion of the steam-piston was at that portion of the stroke accelerating, and the motion of the slide retarding, the steam was somewhat expanded, (or wiredrawn) as the slide or valve closed: hence, then, a small portion of the estimated quantity of high steam may have been, and probably was deficient.

With this small reservation, the cutting off steam at one-third was found very superior to all other proportions for efficiency and economy; and whenever we have since had opportunities of comparing the work performed by a crank engine with the period for cutting off the high steam, we have found our former experience confirmed, and which, it may be seen, is also equally confirmed by the Cornish practice, where the happy application of expansive steam in pumping engines has been unsurpassed, and where the same talent and persevering industry has been employed to perfect the crank engine.

It appears in Mr. Wickstead's paper, in the 2d vol. Trans. of Inst. Civil Engineers, page 65, in a very improved double crank engine, for breaking ores at the Tincroft mine, the steam was cut off at two-fifths the down stroke, and at one-third the up stroke, and the duty exceeded 56,000,000 lbs. lifted one foot high, with one bushel coals. Now, as this duty of 56,-000,000 lbs. performed by a stamping or rotary engine, impelled by expansive steam, is hailed as an extraordinary performance, and in the same paper in which Mr. Wickstead's reports a pumping engine to have performed nearly 118,000,000 lbs. duty, or more than double the duty of the best Cornish crank engine, the fullest confirmation is thus given of the great loss of power, or rather of the lesser power of expansive steam in crank engines—the causes and limits of which, hitherto neglected, we have endeavored to explain.

It may be as well here to observe, that in our engine the slide and valve were each so accurately fitted as effectually to close the passage for high steam at the periods stated; and this observation becomes necessary, from the different and common practice here of employing that ineffective contrivance, the throttle valve, for that purpose, which by only partially closing the passage for high steam, allows some to pass even at first, but admits a considerable quantity to pass towards the termination of the stroke. From the general imperfect nature of these valves, and their coarse construction, the steam becoming much expanded within the cylinder, on one side of the throttle valve, and remaining of great density on the other side, rushes through it with immense velocity towards the termination of the stroke, and the effect of all steam thus admitted to pass, it is well known is much misapplied.

Returning from this digression to our subject—the value of expansive steam—which having been found of full efficiency when cut off at one-third stroke, we are able to ascertain correctly, by the aid of our table, the real gain by expansion, and thus to rightly distinguish between the absurd *no gain* of Mr. Palmer, and the equally enormous and unwarranted assumptions of Prof. Renwick; and we thus are reasonably and satisfactorily assured that the gain by this process alone really equals or rather exceeds the original value of high steam, when used unexpansively in crank engines, while the steam still remains just as applicable to any other useful

purpose, as of heating, drying, warming, or ventilating, as before, still remaining the same definite compound of water and of heat, of enlarged volume only—still unaltered in its chemical constitution; and still as efficient for propelling a low-pressure steam-engine as steam of equal density generated for that particular purpose alone.

We may sum up these remarks, intended for illustration only, by observing:—1. If from a given quantity of high steam a proportionate power is obtained, as commonly it is in this country in an unexpansive high-pressure engine, double that power may be obtained from the same steam in an expansive engine; and a further equal increase of power may be obtained from employing the same steam, subsequently to propel a low-pressure engine; so that, in general terms, we may double the power of the high steam by using it expansively, and treble its power by again using it in a condensing engine.—2. The converse of these propositions must be equally true—that steam, as commonly employed in low-pressure English engines, and as advocated by Mr. Palmer as unsurpassable, may be first previously employed to propel a high pressure engine, or an expansive high-pressure engine, and thus made to furnish an equal power, or a double power, previous to again employing as profitably the same steam as in Mr. Palmer's inimitable. Thus, probably, may almost every factory engine in existence, every locomotive that runs, or steamboat that floats, be improved in one or more of those important particulars—either in economy, power, or safety.

That much more than all this has been done in the Cornish pumping engines, is well known, and we have shown why it can be so done; and in our next we will endeavor, by an analysis of the properties of the pumping engines, to show why a much greater duty may be reasonably expected from them than has yet been reported, and extending our remarks to the general employment of expansive engines in the steamers of this section of the United States, we shall show that these engines are as unaccountably avoided, by the unwarranted prejudices of the English engineers, as they are here rendered unnecessarily hazardous.

From the positive and undeniable facts brought forward, each susceptible of easy and distinct proof, what a mean view must we not take of the inefficient, extravagant, and dangerous modes commonly employed for obtaining motive power from steam, merely from a disregard, amounting to almost total neglect, of contingent advantages, that would as extensively benefit society as greatly add to the honor of the national character! For, after all these separate, distinct and repeated uses of steam, even after it has been condensed in a low-pressure engine, no portion of the heat has even then become latent, or hidden, or lost, but still remains sensible and apparent—is still to be all found in the warm or hot water flowing from the engine; and what is of more consequence, may still be again employed to great advantage and considerable profit in cities or other populous places, where the now extended use of steam might and ought to be employed to procure inestimable advantages to society, by furnishing unlimited means of cleanliness, with increased comfort and health, by an abundant, constant supply of tepid and warm baths, at such a trifling expense as would secure their free use to the whole population. Thus all classes, however humble, might enjoy this comfort, pleasure, and inexpensive luxury, at present unknown even to the most opulent, and from which they are alone debarred by penury of thought.—*American Repertory.*

Steamboat Challenge for 1000 *Guineas.*—The patentee of the screw-propeller invention now in operation in the *Archimedes* has published a challenge for the above sum to any steam vessel worked by paddle wheels,

and of the same steam power, tonnage and draft as the *Archimedes.* The trial to take place in the open seas, over the distance of 400 to 500 miles, before the 15th October. This challenge does not extend to vessels with high pressure engines. The name and address of the challenger are F. P. Smith, Wade's Terrace, London.

RAILROADS IN THE UNITED STATES.—By Chevalier De Gerstner.

RAILROADS IN THE STATE OF PENNSYLVANIA.

The first railroad in America was constructed in Pennsylvania, and the same State has at present the greatest extent of railroads in operation. With the exception of only two lines, all have been constructed by private companies. Some of those established at an early period were designed exclusively for the transportation of coal from the mines to the place of their transhipment. For the construction of these roads little regard was paid to the grades and curvatures; and inclined planes were frequently resorted to. The other railroad lines, generally of a much greater length, are used for the transportation of passengers and freight. The manner of construction of the different railroads in this State is very various, and it is of great interest to follow all the improvements made in this respect since the construction of the Mauch Chunk railroad, finished in 1827, up to the present time, when all the experience acquired during 13 years is brought into application; on the Reading railroad, for instance. With the exception of some of the oldest coal railroads, the tracks have an uniform width of 4 feet 8½ inches, the same as was adopted in England. The superstructure is generally of wood—flat bars upon continuous bearings, or heavy T rails upon wooden cross ties. As motive power, stationary and locomotive steam engines, horses and mules, and gravity, are used.

The following table contains a list of all the railroads in the State of Pennsylvania either completed or in progress of construction, in 1839, and has been prepared after a personal examination of the different works:—

1. In the whole there are 40 different railroad lines in the State of Pennsylvania, 2 of which were constructed by the State, and 38 by private companies. The longest continuous line of railroad now in operation in the State, is that from Philadelphia to Greencastle, a distance of 163 miles; and the total length of railroads, which were in use at the close of 1839, is 576½ miles; there were besides 161½ miles nearly completed, and 112¼ miles to be constructed, making the total length of all the railroads in the State, when completed, equal to 850¼ miles.

2. The number of locomotive engines employed for the transportation of passengers and freight in the State of Pennsylvania is 114; they run upon 16 railroads with an aggregate length (in operation) of 485 miles, being 1 locomotive engine for 4¼ miles of railroad. In some of these railroads stationary steam power is also applied.

3. The above statement contains the amounts already expended on 26 railroads, and their ultimate total cost; of the other roads the exact amounts have not been ascertained. If we compare the length of these 26 railroads, which is 686¼ miles, with their total cost of $19.867,450, we find the average cost per mile $28, 950. At a fair estimation, the amount already expended on those works, not comprised in the above 26, and being 164 miles in extent may be put down at $2,410,000, and their ultimate cost at $3,200,000, we then have:

Total amount expended for railroads in Pennsylvania,	$18,050.450
Amount yet to be expended on works under construction,	5,017.000
Total cost of all the railroads, when completed,	$23,067,450
And the average cost per mile, " "	27,130

RAILROADS COMPLETED AND IN PROGRESS IN THE STATE OF PENNSYLVANIA.

No.	Name of Railroad.	From and to where.	Opened. Year.	Opened. Miles.	No. of miles. Besides graded.	No. of miles. Not yet c'nstr'd.	Total length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended	Amount wanted for completion.	Total cost of road.	Cost per mile.
1	Philade'phia & Colum.	Philadelphia to Columbia.	1834	82			82	41 lbs.	36 locomot's	4,000,000		4,000,000	48,780
2	Alleghany Portage,	Johnstown to Hollidaysburg.	1834	$36\frac{2}{3}$			$36\frac{2}{3}$	$39\frac{1}{2}$ lbs.	17 "	1,850,000		1,850,000	50,450
3	West Chester,	Columb. and Phil. R. R. to W. Chester.	1834	9			9	$2\frac{1}{4} \times \frac{5}{8}$	horses.	90,000		90,000	10,000
4	Valley,	Columbia and Phild's R. R. to Norristown.			10	$10\frac{1}{4}$	$20\frac{1}{4}$						
5	Phild'a., Germantown,	Philadelphia to Germantown											
6	Norristown,	and Norristown.	1837	$20\frac{1}{4}$			$20\frac{1}{4}$	40 lbs.	8 locomot's				
7	Philadelphia & Reading	Philadelphia to Mt. Carbon.	1839	$54\frac{1}{2}$	15	$32\frac{1}{2}$	102	45 lbs.	7 "	2,976,000	1,614,000	4,590,000	45.000
8	Philadelphia & Trenton,	Philadelphia to Trenton.	1833	30			30	$2\frac{1}{4} \times \frac{5}{8}$	5 "	400,000		400,000	13,333
9	Philad. & Wilmington,*	Philadelphia to Wilmington.		28			28	$2\frac{1}{4} \times \frac{5}{8}$	4 "	500.000		500.000	17.857
10	Harrisburg & Lancaster	Harrisburg to Lancaster.	1837	36			36	$2\frac{1}{4} \times \frac{5}{8}$	8 "	860,000		860,000	23,900
11	Cumberland Valley,	Harrisburg to Chambersburg.		46			46	$2\frac{1}{4} \times \frac{5}{8}$	8 "				
	Franklin,	Chambersburg to Williamsport	1839	$10\frac{1}{2}$	6	$7\frac{1}{2}$	24		1 "				
12	York and Wrightsville,	York to Wrightsville.			13		13	58 lbs.					
13	Mauch Chunck,	Mauch Chunck to Coal Mines.	1827	9			9	$2 \times \frac{1}{2}$	mules	100,000		100,000	11,110
14	Room Run,	Near Mauch Chunk to Mines.	1833	5			5	$2 \times \frac{1}{2}$	mules	150,000		150,000	30,000
15	Beaver Meadow,	Beaver Meadow to Parryville.	1836	26			26	$2\frac{1}{4} \times \frac{5}{8}$	6 locomot's	360,000		360,000	13,846
16	Hazleton Branch,	Hazleton to Beaver Mead. RR.	1838	10			10	$2\frac{1}{4} \times \frac{5}{8}$	3 "	120,000		120,000	12,000
17	Sugar Loaf Summit,	Branches to Beaver Meadow.	1839	2	2		4	$2\frac{1}{4} \times \frac{5}{8}$	1. "	30,000	10,000	40,000	10,000
18	Buck Mountain,	Buck Mountain Coal Mines to Lehigh.			$4\frac{1}{3}$		$4\frac{1}{3}$	38 lbs.		100,000		100,000	23,077
19	Susquehanna & Lehigh,	Wilkesbarre to Whitehaven.			$20\frac{1}{2}$		$20\frac{1}{2}$	57 lbs.		600,000	400,000	1,000,000	48,785
20	Little Schuylkill,	Port Clinton to Tamaqua.	1831	22		7	29	2×0.44	5 locomot's	400,000	100,000	500,000	17,241

*The Philadelphia and Wilmington railroad now forms a part of the Philadelphia, Wilmington aud Baltimore railroad; the whole of which has cost $4,400,000.

RAILROADS COMPLETED AND IN PROGRESS IN THE STATE OF PENNSYLVANIA.—CONTINUED.

No.	Name of railroad.	From and to where.	Opened. Year.	Opened. Miles.	No. of miles. Besides graded.	No. of miles. Not yet constr'd	Total length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion.	Total cost of road.	Cost per mile.
21	Little Schuyl. and Sus.	Catawissa to Little Schuy.RR.			39		39	50 lbs.					
22	Beaver Meadow Extension.	Little Schuylkill & S. R. R. to Beaver Meadow R. R.			12		12	50 lbs.		850,000	1,000,000	1,850,000	36,275
23	Schuylkill Valley,	Port Carbon to Tuscarora.	1830	10			10	$1\frac{1}{2} \times \frac{3}{8}$	horses	65,000		65,000	6,500
24	Mill Creek,	Port Carbon to Coal Mines.	1830	5			5	$1\frac{1}{2} \times \frac{3}{8}$	horses	45,000		45,000	9,000
25	Branches to both,	From different Mines.		12			12	$1\frac{1}{2} \times \frac{3}{8}$	horses	54,000		54,000	4,500
26	Mount Carbon,	Mount Carbon to Minehill.	1831	7			7	$2\frac{1}{4} \times \frac{5}{8}$	horses	118,000		118,000	16,854
27	West Branch,	Schuylkill Haven to Minehill and branches.	1831	18			18	$7\frac{1}{2}$&35, lbs.	horses	315,450		315,450	17,525
28	Pottsville and Danville,	Pottsville to Sunbury.	1838	$29\frac{1}{2}$	3	10	$42\frac{1}{2}$	$2 \times \frac{1}{2}$&$2\frac{1}{4} \times \frac{5}{8}$	2 locomot's	670,000	200,000	870,000	20,470
29	Williamsport & Elmira,	Williamsport to Pa. State line.	1839	25	1	41	67	$2\frac{1}{4} \times \frac{3}{4}$	1 "	437,000	903,000	1,340,000	20,000
30	Blossburg & Corning,	Blossburg to Pa. State line.			$25\frac{3}{4}$		$25\frac{3}{4}$	$2\frac{1}{4} \times \frac{3}{4}$	2 "	250,000		250,000	9,709
31	Carbondale,	Carbondale to Honesdale.	1829	$16\frac{1}{2}$			$16\frac{1}{2}$	$1\frac{1}{2} \times \frac{1}{2}$&$2\frac{1}{4} \times \frac{1}{2}$	horses and stat'n'ry eng	300,000		300,000	18,182
32	Pine Grove,	Union Canal to Coal Mines.	1830	4			4		horses				
33	Lykens Valley,	Millersburg to Bear Gap Mines	1830	$16\frac{1}{2}$			$16\frac{1}{3}$		horses				
34	Bear Creek,	Pottsville & Danville R. R. to Coal Mines.			2	2	4						
35	West Philadelphia,	Philad'a. & Columbia R. R. to river Schuylkill.			8	2	10						
39	Philadelphia,*	Within the city of Philad'a.		6			6	$2\frac{1}{4} \times \frac{5}{8}$	horses				
				$576\frac{1}{2}$	$161\frac{1}{2}$	$112\frac{1}{4}$	$850\frac{1}{3}$		114 l'com't's				

*The railroads in Philadelphia are:—the City railroad, 2 1-4 miles; N. Liberties and Penn Township, 1 1-4 miles; Southwark railroad, with branch, 2 1-2 miles

AN ESSAY ON THE BOILERS OF STEAM ENGINES. By A. Armstrong, Civil Engineer.

EXPLOSIONS.

Explosions of steam boilers have occurred so frequently of late years, and have been attended with such disastrous consequences, particularly when they have happened in steam packets, that the subject calls loudly for legislative interference. In America, where the explosions of steam packet boilers have been more frequent, from the general use of high pressure engines, some legislative restrictions have been recently adopted, founded upon a set of very ably conducted experiments, peculiarly adapted to the practice in that country. A few points, however, remain open to investigation; and as the subject must be one of intense interest to all those who, with a laudable anxiety for improvement, combine a proper regard for the welfare of their fellow-creature, we shall examine as much of it as regards the safety of the ordinary low pressure boiler, as generally used, and which comes more particularly within the scope of this essay.

It is freqnently observed that a boiler of about thirty horse power will require from a ton to a ton and a half of coal extra, during the first day after it is cleaned out. This arises from the practice of cleaning out the boilers, as well as the flues, by means of human beings, instead of mechanical contrivances, although the latter are easily available for both purposes. The means of effecting the former have been already described, and have been adopted to a considerable extent; but we have not such sanguine expectations that similar means of cleaning out the flues will be so readily adopted, the pecuniary advantage resulting therefrom not being so apparent as in the other case,

The ordinary practice in Manchester is to clean out the boilers once a month, and to clean out the flues at the same time; preparatory to which the boilers mostly require filling once or twice with cold water, to cool them: consequently, in getting up the steam the next morning, there is not only all the extra fuel required for heating the comparatively cold water, but quite as much more is required to bring up the mass of brick-work, and all the adjacent parts, to their former temperature. It is of little or no avail that there may be a spare boiler kept, for the cooling of it is still necessary, either by standing a week, or in one way or other, and of course the loss is the same.

It generally happens, that the spare boiler, if there be one, stands immediately adjoining those that are constantly at work, and the heat from the adjacent boilers and brick-work renders it quite impossible to clean out the flues without an amount of individual suffering which few people have any idea of. The ordinary climbing boys are not generally employed to sweep the flues of a steam-engine boiler in a factory; a strong man usually is required for the purpose. Quite a different sort of manual process is necessary than that used for sweeping a common house chimney; indeed the latter must be, comparatively, a pleasant occupation. In the former case the man has to *worm* himself through the flues, in a horizontal position, pushing before him the contents of the flue, or "flue dust" as it is called; which is not soot, but a heavy kind of deposit, consisting of very fine ashes, being the burnt earthy particles of the fuel, which are fine enough to be carried forward with the draught. The most expert hands at this kind of work are generally natives of the sister isle, who are ever ready, for the smallest pittance, to undertake this drudgery, and with whose labor, as to value (at least as to price) it is in vain to attempt competition with machinery. It is from the above mentioned class of men that the stokers or firemen for the steam engines in Manchester and Liverpool are generally ob-

tained; and certainly there are none so capable of being made good firemen as intelligent Irish laborers, especially if they have been previously good spademen.

The foregoing may seem to bear only very remotely on the question of explosions, but it is rendered necessary in order the better to elucidate a view of the subject, according to which it is believed we may account for the great majority of the explosions which have occurred in factories and other large works.

It is a fact very well known, that many of the explosions of steam boilers, which have occurred of late years in the factories in this district, have taken place on Monday mornings, a little before six o'clock, and it is generally believed that the whole of those have done so, whose causes have not been hitherto clearly ascertained. Now if we take into consideration that the fireman have generally the charge of cleaning out the boilers and flues, and that along with this they are commonly charged not to be seen doing their work on a Sunday; then, bearing in mind what we have stated, of the difficult nature of the operation, rendered still more difficult when it is obliged to be done on a week day, when the fires are burning in the adjoining furnaces, perhaps one on each side, merely separated by a thin brick wall, adding to this the necessity of keeping the damper of the spare boiler closed, otherwise the fires under the other boilers do not burn properly,—this work has, on all these accounts, generally become a night job, consequently there can be little superintendence of either masters or managers, and therefore it is not to be wondered at if the boilers and flues very frequently go without any cleaning at all.

In illustration of the usual routine of the fireman's business, we may state that it sometimes goes on this way:—Suppose the getting up of the steam to require three or four hundred-weight of coal extra on the Monday morning of the second week after the boiler and flues have been cleaned; the Monday morning after that it will require five or six hundred-weight, and thus it will go on requiring a few hundred-weight more at the commencement of each week than in the preceding one, until the boiler goes several weeks without being let off—the consumption of fuel going on all the while in an increasing ratio, along with an increased difficulty of raising the steam, until, at last, the poor stoker sometimes finds that he cannot raise the steam at all. This is, of course, a consummation that rarely takes place in regular factories, where there are seldom fewer than two or three boilers, and therefore the steam which cannot be obtained from one boiler must be had from another; but at collieries, and in many country places, where there may be only one boiler to an engine, it occasionally occurs. Now, the consequence in the majority of those cases, is generally of little account, excepting on the score of economy, for the boiler has only to be let off and re-filled, and all is right again; but it is altogether very different at a factory, where there may be a good chimney and a strong draught, and also several hundred workpeople depending upon the engine starting at the proper time,—in such a case, as it is sometimes significantly expressed by the enginemen, there must be steam or else a *blow-up* of one kind or other.

Most people are aware of the rage for building very large factory chimneys, during the last few years, and as they are usually built much larger at first than the wants of the factory require, there is always a surplus draught, which, by setting the main damper wide open, can be taken advantage of to any extent, and in many cases to cause an intensity of heat almost equal to that in a blast furnace. Where this surplus draught is easily available, the fireman has little to do but open his dampers, and the steam is got up in one half the time that it required formerly.

Whether the boiler is dirty, or has too much water in it, one consequence is the same, under ordinary circumstances, namely, a greater length of time is required for getting up the steam, and this necessarily requires the earlier attendance of the fireman. Now the fireman is not generally summoned at a certain hour like the regular mill hands, and if he can only contrive to get up the steam in sufficient time for the engine starting at the appointed minute, there is seldom any fault found; therefore any expedient which will enable him to prolong the period of his commencing work is not likely to be neglected, and such an expedient he has wherever there is a good draught.

It unfortunately happens that, in this matter, the apparent interests of the manufacturer and the real interests of humanity do not agree; for it has been incontestibly proved, that a strong draught is extremely favorable for saving fuel, as may be judged from the fact, that the time for getting up the steam has been in some instances reduced from upwards of an hour, to twenty or twenty-five minutes, and although the saving of coal has not been in any thing like that proportion, yet it has been very considerable.

Under similar circumstances to those just mentioned, there can be no doubt that a portion of the boiler bottom occasionally becomes nearly red hot, although this condition appears extremely inconsistent with the supposition that it is at the same time covered with water; yet we have been compelled to adopt this conclusion, from having had ocular demonstration of its possibility, as well as other reasons. We had frequently heard the fact stated by intelligent enginemen, and had more than once been called to witness it, although even then inclined to consider it a mistake, owing to the difficulty of ascertaining it clearly; for a slight approach to the incandescent state must be nearly invisible, owing to the strong glare of light from the furnace directly beneath, while any degree of heat much higher would be sure to weaken the iron so much as to cause the boiler bottom to give way.

In one instance, however, the rivet heads appeared to be approaching to a redness, and we immediately took care to ascertain that sufficient water was in the boiler. On returning to the furnace, we observed a circular space, of six or eight inches in diameter, in one of the plates over the middle of the fire, "drawn down" into a spherical segment, or swelling, of about two inches in depth, something similar in appearance to those formed on a smaller scale in glass blowing, but its further protrusion had evidently been checked by the sudden opening of the fire-door, and which no doubt prevented any serious consequence at the time. The boiler was a cylinder, of nearly six feet in diameter, and the pressure was about nine or ten pounds to the square inch. The occurrence took place just at the moment of the steam being sufficient to blow away at the safety valve, and a few minutes before the engine started. For a few days afterwards, this segmental protuberance was observed to increase gradually to a hemispherical shape, of three or four inches in depth, when it burst without doing any further damage than putting out the fire.

It is well known to engineers, that a similar bulging out of a portion of the bottoms of cylindrical boilers, when the fire-grate is placed too near, is a very common occurrence, and we have known boilers to work for several weeks, and even months, without bursting, after those swellings had been first formed. A precisely similar swelling to that above mentioned, took place a short time before, with a boiler of the same kind, at the same works. The chimney at these works was of an immense size, consequently the draught was extremely strong, and it was the boast of the engineer that he could, when he liked, have the steam up in a quarter of an hour,—

it ought to be added, that it was also the boast of his master that he could burn the worst possible kind of coal.

The probability of boiler bottoms sometimes approaching a red heat, receives a corroborative proof on examination of the iron plates, in many cases, where the boilers have bulged out in the manner we have been describing, and which exhibit an appearance, well known to boiler-makers by a peculiar color in the iron surrounding the part which has been red hot.

Whenever a boiler bottom is seen in this state, of course the only method of avoiding danger is to slack the fire immediately, by opening the fire-doors. But it frequently happens that the fireman thinks the boiler is empty, and, if he has an opportunity, he immediately lets into it a quantity of water, when the consequence uniformly is, that the boiler bursts instantly.

From what we have stated above as the common practice in the factory districts, we may conclude that the principal cause of boilers becoming unduly heated is undoubtedly, in a majority of cases, owing to the interposition of indurated, or encrusted earthy matter, between the heated iron and the water, and the manner in which those circumstances operate in producing an explosion appears to be as follows: we have before shown, (Art. 253,) that an internal coating of boiler scale is liable to crack and separate into large pieces, which are thrown off from the boiler bottom with a certain degree of violence, at some particular degree of temperature, depending upon the thickness of the scale and the kind of substance of which it is formed. This may account for some of those detonations, or reports, said to be heard immediately previous to explosions. It may be noted here, that the scale, when very thick, is always found to come off much easier, and is consequently detached by a lower temperature, than when it consists of merely a thin coating of carbonate or sulphate of lime; in the latter case it requires a much higher temperature, and only comes off in small patches of a few inches in diameter.

We may easily suppose, that by unduly heating the boiler, a large portion of scale may be suddenly detached, uncovering one or two plates, at a temperature something exceeding the *mamimum evaporating point*, which is well known to be considerably under the lowest red heat of iron (by the American experiments it is at about 400° Fah.). Then, the first effect produced will evidently be a certain amount of repulsion between the overheated iron and the water, which may continue for several seconds, and perhaps for a few minutes: this may account for the sudden *decrease* in the supply of steam, which has frequently been observed for a few moments just before the explosion of a boiler has taken place.

The next effect must arise from a gradual diminution of temperature, during the same short space of time, in that part of the over-heated iron which is exposed to the water,—creating a contraction of the metal, increasing rapidly as the temperature approaches the evaporating point, and causing a corresponding strain upon the rivets in the boiler bottom. The direction of this strain may generally be traced on examining the bottom plates of any old boiler; it is always found to radiate in lines proceeding from that plate or part of the boiler bottom which has been most acted on by the fire, and is usually indicated by short cracks or rents between the rivet holes and the edges of the plates.

The next and concluding step, in case of the materials not being able to withstand the strain superinduced by the contracting metal, must be the sudden giving way of some bad seam of rivets, which the most nearly coincides with what would otherwise be the true line of fracture, and which may possibly be at some considerable distance from the plate which is the most heated; thereby giving the effect of a great leverage to the pressure

acting upon all that portion of the boiler bottom included within the actual line of fracture. Now the consequence is, not perhaps that this portion is blown out, as would most probably be the case with a cast iron boiler, but it will be bent or doubled back, the line of flexure running across the hottest or weakest part of the iron. A rupture being thus effected, an explosion is inevitable, if the hole made by it be sufficiently large.

(To be Continued.)

FOURTH ANNUAL REPORT OF THE PRESIDENT AND DIRECTORS TO THE STOCKHOLDERS OF THE L. C. AND C. RAILROAD COMPANY.

The last annual report from our much lamented President at Ashville, and the report from Mr. King, on whom devolved, for a time, the temporary management of the concerns of this company, at the adjourned meeting at Columbia in December last, exhibit a full statement of the condition and affairs of the Louisville, Charleston and Cincinnati railroad company up to those periods. The proceedings and resolutions of the stockholders at those meetings, as instructions to the board of directors, have since been fulfilled to their full extent, where obstacles probably unanticipated, did not interpose.

Upon application to the legislature of South Carolina, a loan of $600,-000, in six per cent. bonds, as an advance upon the State subscription to the road, was obtained, and promptly applied, under the direction of my immediate predecessor in office, at its par value, to the extinguishment, in part of the company's obligations for the purchase of the Hamburg road.

An extension of the charter of the south western railroad bank for twenty years, within the limits of the State of South Carolina; and with a capital of three millions of dollars, was likewise granted, on the condition, that the road to Columbia be completed within three years from the first of January last. The surveys and operations beyond Columbia as directed, have been suspended, and the road to that place urged with all the despatch which the means of the company and State, and conditions of the contracts entered into would warrant. A system of economy and of retrenchment of expenditure has been commenced, and is maturing as rapidly as circumstances will permit. The engineers in service were reduced at the commencement of the year to four and since to three officers, and their salaries as prescribed, apportioned to the duties rendered. The other officers of the company are a President, a Secretary and Treasurer and a clerk, as few probably as could perform the duties devolving on them, increased as they have been by a system of finance which it has been found necessary to adopt. The progress with the road to Columbia imposed on the company by a due regard to its own interests, as well by the liberal additional grants of the South Carolina legislature to the enterprise, the exercise of the authority of the stockholders to the board of directors to issue obligations became necessary. They were the more inclined to this measure as it appeared to have met with the concurrence of the contractors, all of whom signed communications expressing their willingness to receive these promissory notes at twelve months date, drawing interest in payment for work done and materials furnished. To make them, however, available to the fullest extent, and subjected to the least possible depression in value, the denominations, with the approbation of the board, and at the request of the contractors, who could not readily dispose of the larger bills, were somewhat varied from those in the resolution, five, and twenty dollar notes being substituted for the fifty dollars; and in addition, small change bills of various denominations less than five dollars, (and which have proved an

accommodation to the road and the community,) have, to a limited amount, been issued—and all of them without discrimination, been made receivable for dues to both the South Carolina canal and railroad, and the Louisville, Cincinnati and Charleston railroad companies. Circumstances have contributed favorably to the circulation of these obligations; and thus far they have so performed their functions as to enable this company to progress with the road. The system of credit, however, to rear up a work, which when finished will not probably yield an interest much greater than that paid for the money borrowed, is of very doubtful policy. It necessarily increases the cost of construction, and enhances incidental expenses. At any period it is objectionable, but particularly so when a general distrust of all paper issues, and of promises to pay, seem to pervade the community. The withdrawal, therefore, at maturity, of all the notes issued, and the prompt payment in cash of instalments as they become due, is recommended by the best interests of the stockholders, and credit of the company. The sooner the road is finished, and all the obligations contracted, extinguished, the sooner may its cost be estimated as capital invested, and on which remunerating dividends may be declared.

The calls for instalments on the road had been limited in the resolutions passed at Columbia, *to four*, and the periods fixed to the 1st of February, 1st of May, and 1st of November, 1840, and 1st of February 1841. At the time when this resolution was passed, and in conjunction with others, imposing on the direction the all important obligations of extinguishing the pressing debt to the South Carolina canal and railroad company; and the urging forward, with all possible despatch, the road to Columbia, accompanied with an application to the legislature of South Carolina for an advance of but $600,000, instead of for the whole remaining amount $800,000 of the State subscription, which with the same liberality no doubt would have been accorded, the committee of stockholders must have overlooked the detailed report of the chairman of the committee of finance at Ashville in September last, exhibiting the then immediate and pressing liabilities, of the company at $1,289,349.

The third instalment for the purchase of the Hamburg road due on the 1st of January, 1840, was alone $877,180. It required, therefore, $277,180 over and above the State advance, to extinguish this imperative engagement alone; and this could only be effected by a loan from the south-western railroad bank, with a pledge for re-payment, of the first receipts on instalments from the stockholders. This pledge, which afterwards interposed an obstacle to the receiving of the company's promissory notes from its stockholders in payment for stock, *and which was important to sustain their credit*, was snbsequently relinquished in part by the bank, and without which confiding arrangement with that institution, the system of finance which had been resorted to, would probably have been seriously embarrassed. Though the ultimate liquidation of the past and accruing obligations of the company may, by these promissory notes, be advantageously postponed for a time; yet the continued confidence of the community in this paper, *which is necessary to its performing the functions for which it was intended* can only be sustained by the certainty, of that portion, which is not absorbed in payments of dues to the respective companies bound to receive them, *being redeemed at maturity.*

The calls for instalments therefore, as limited by the periods in the resolution passed at Columbia; rendering it very doubtful whether the receipts could be equal to the probable amount of paper required to be issued; and as the calls thereafter restricted by the charter to $5, at intervals of sixty days, would preclude the possibility of commanding the means ne-

cessary to complete the road to Columbia, within the period fixed by the legislature; your directors had the alternative presented of either suspending the work, and thereby loosing what had been done, and forfeiting the privileges extended to the south-western railroad bank; or of throwing themselves, at once, upon the powers of the charter; and of exacting payments from share owners every sixty days, until an amount equal to the obligations of the company could be raised. The latter measure after much deliberation, was preferred, as more in accordance with the increasing confidence in the enterprise; and with the best interests, and honor of the company represented by your board of directors. A pledge had been given, and those who subscribed their names to the promissory notes of the corporation, have now every guaranty, that they will be honored at maturity; and that the road will steadily progress to Columbia.

The subject of most intricacy and delicacy, one on which the board have not been able yet to act definitively; and which was brought, in a series of resolutions, to the notice of the company at the adjourned meeting at Columbia in December last, is the real relations of the several class of stockholders to the corporation of which they are, or were, in the first instance, members. The extent of their liabilities or exemptions, and the course dictated towards those who stand reported on the instalment book as defaulters. On this subject as directed, legal advice was taken by my predecessor Mr. M'Bee; and, although the opinion of an able counsellor seemed to give uncontrolled legal power over share owners, to the full extent of their subscription, yet it remained a question of great doubt with a great majority of the directors, how far it would be expedient, on the part of the company, to resort to a legal enforcement against those disposed to contend. If there were any doubts of the company's ability to meet ultimately all its engagements; if there were any misgivings as to its pecuniary responsibility, there might be an obligation, in justice to third parties; imposed, of of holding on to every name on the subscription lists, whether willing or not, as a member of the concern, and as equally liable individually for its engagements. To attempt, however, to enforce this through the courts of the country, and to bring the company in hostile array with many, who assert *forfeiture* as a privilege, to be exercised at their option, is a subject of most doubtful policy; not enforced by necessity, and not recommended by the interests of the company, or of those who are still willing to stand by and preserve their connection with it. That forfeiture, however, is a penalty, which on default of a stockholder, may be imposed by the company, is admitted by all. The charter is not ambiguous on that point—and whether it should not be applied at once against all those who refuse to contribute any more, and assert it as a privilege, is strongly recommended to the consideration of the stockholders—beginning with those who have paid but two instalments to the road; and so on extending the declaration of forfeiture gradually to those who are deficient on the other instalments until every willing delinquent is separated, as a member, from the corporators. It may be assumed, however, as a fact, which will be demonstrated in the result, that no share owner, who has paid three instalments on the road, and two in bank, will expose his shares to forfeiture.

(To be continued.)

Railway Fares are most profitable (whether high or low) when they fill the trains; because you can carry 200 passengers in a train for about the same expense that you can carry 40.

The question, then, is, how to fill up the trains; and it is found, by Parliamentary inquiry, in Great Britain, that the true way, in every instance, in various railways, is to put the fare low; and *that the low fare gives the largest nett income to the road.*

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 10, Vol. V. New Series. | NOVEMBER 15, 1840. | Whole No. 370. Vol. XI.

MANUFACTURE OF BRICK.—YELLOW DUTCH BRICK.

It may be remembered by our readers, that some time since we published some queries from a correspondent in relation to seasoning timber, and also to the manufacture of the yellow Dutch brick, formerly imported into this country, and of which we yet have specimens in some of our old buildings in New York. We republish as much of this communication as relates to the latter subject, having sometime since disposed of the former.

"What is the Dutch mode of making the little yellow bricks of which the oldest houses of our city are composed? Is their color owing to the kind of clay used—the mode of burning them—or to both? Are they very much compressed in making, or to what cause is owing their great hardness and durability? Can bricks of such quality be made in this country, and what place furnishes clay of proper quality?

"I make these inquiries partly for obtaining information for my own use, and partly in the hope that they may lead others to think of the superiority of the Dutch brick, both as a matter of taste, as regards color, and of durability, (of both of which, I think, there is little room to doubt,) and thus promote the adoption of them in place of the crumbling, staring red bricks of which our cities are so generally built; and the chief qualities of which are, hardness to the eye, and softness under the mellowing hand of time.

Yours, D*** F****."

We agree with our correspondent fully in his preference of the color and other good qualities of the Dutch brick so much prized by our ancestors, and although a part of his query might easily have been answered we were induced to inquire more fully into the subject, and having much that was of interest as well as use, we could not easily condense the information obtained. We shall at present give some account of the mode of manufacture in Holland, and also show the importance of a more carefully conducted process than is usually followed in the formation of brick for hy-

cessary to complete the road to Columbia, within the period fixed by the legislature; your directors had the alternative presented of either suspending the work, and thereby loosing what had been done, and forfeiting the privileges extended to the south-western railroad bank; or of throwing themselves, at once, upon the powers of the charter; and of exacting payments from share owners every sixty days, until an amount equal to the obligations of the company could be raised. The latter measure after much deliberation, was preferred, as more in accordance with the increasing confidence in the enterprise; and with the best interests, and honor of the company represented by your board of directors. A pledge had been given, and those who subscribed their names to the promissory notes of the corporation, have now every guaranty, that they will be honored at maturity; and that the road will steadily progress to Columbia.

The subject of most intricacy and delicacy, one on which the board have not been able yet to act definitively; and which was brought, in a series of resolutions, to the notice of the company at the adjourned meeting at Columbia in December last, is the real relations of the several class of stockholders to the corporation of which they are, or were, in the first instance, members. The extent of their liabilities or exemptions, and the course dictated towards those who stand reported on the instalment book as defaulters. On this subject as directed, legal advice was taken by my predecessor Mr. M'Bee, and, although the opinion of an able counsellor seemed to give uncontrolled legal power over share owners, to the full extent of their subscription, yet it remained a question of great doubt with a great majority of the directors, how far it would be expedient, on the part of the company, to resort to a legal enforcement against those disposed to contend. If there were any doubts of the company's ability to meet ultimately all its engagements; if there were any misgivings as to its pecuniary responsibility, there might be an obligation, in justice to third parties; imposed, of of holding on to every name on the subscription lists, whether willing or not, as a member of the concern, and as equally liable individually for its engagements. To attempt, however, to enforce this through the courts of the country, and to bring the company in hostile array with many, who assert *forfeiture* as a privilege, to be exercised at their option, is a subject of most doubtful policy; not enforced by necessity, and not recommended by the interests of the company, or of those who are still willing to stand by and preserve their connection with it. That forfeiture, however, is a penalty, which on default of a stockholder, may be imposed by the company, is admitted by all. The charter is not ambiguous on that point—and whether it should not be applied at once against all those who refuse to contribute any more, and assert it as a privilege, is strongly recommended to the consideration of the stockholders—beginning with those who have paid but two instalments to the road; and so on extending the declaration of forfeiture gradually to those who are deficient on the other instalments until every willing delinquent is separated, as a member, from the corporators. It may be assumed, however, as a fact, which will be demonstrated in the result, that no share owner, who has paid three instalments on the road, and two in bank, will expose his shares to forfeiture.

(To be continued.)

Railway Fares are most profitable (whether high or low) when they fill the trains; because you can carry 200 passengers in a train for about the same expense that you can carry 40.

The question, then, is, how to fill up the trains; and it is found, by Parliamentary inquiry, in Great Britain, that the true way, in every instance, in various railways, is to put the fare low; and *that the low fare gives the largest nett income to the road.*

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 10, Vol. V. New Series. | NOVEMBER 15, 1840. | Whole No. 370. Vol. XI.

MANUFACTURE OF BRICK.—YELLOW DUTCH BRICK.

It may be remembered by our readers, that some time since we published some queries from a correspondent in relation to seasoning timber, and also to the manufacture of the yellow Dutch brick, formerly imported into this country, and of which we yet have specimens in some of our old buildings in New York. We republish as much of this communication as relates to the latter subject, having sometime since disposed of the former.

"What is the Dutch mode of making the little yellow bricks of which the oldest houses of our city are composed? Is their color owing to the kind of clay used—the mode of burning them—or to both? Are they very much compressed in making, or to what cause is owing their great hardness and durability? Can bricks of such quality be made in this country, and what place furnishes clay of proper quality?

"I make these inquiries partly for obtaining information for my own use; and partly in the hope that they may lead others to think of the superiority of the Dutch brick, both as a matter of taste, as regards color, and of durability, (of both of which, I think, there is little room to doubt,) and thus promote the adoption of them in place of the crumbling, staring red bricks of which our cities are so generally built; and the chief qualities of which are, hardness to the eye, and softness under the mellowing hand of time.

Yours, D*** F****.

We agree with our correspondent fully in his preference of the color and other good qualities of the Dutch brick so much prized by our ancestors, and although a part of his query might easily have been answered we were induced to inquire more fully into the subject, and having much that was of interest as well as use, we could not easily condense the information obtained. We shall at present give some account of the mode of manufacture in Holland, and also show the importance of a more carefully conducted process than is usually followed in the formation of brick for hy-

dralic and other works intended to be more durable than common erections.

In the first place, the yellow brick of Holland is made from clay or mud scooped up from the bottom of the river Yssel, and probably from other rivers, or even ditches, through which a moderate current flows allowing of the deposition of this kind of sediment. This clay well tempered is moulded and burned in kilns adapted to the use of peat as a fuel. The peat employed gives out a clear flame of considerable volume, and leaves but little ashes. The heat is kept up for *three or four weeks and about three weeks more are allowed for the brick to cool* before being removed. Formerly, and we presume even yet, this branch of manufacture was subject to certain regulations which were well calculated to maintain the superiority of the bricks. For instance, the time of operation was limited to certain seasons in such a manner as to prevent the possibility of damage by frost in drying.

The harder burnt bricks, called klinker, are partially vitrified, and although not suitable for building, yet from their extreme hardness, are even yet imported into England for paving.

In addition to this, we find that the finer bricks used in and near London, and which are preferred on account of their greyish and more pleasing color, are made by adding a certain portion of *Thames sand*, and sometimes *bituminous coal ashes.* These bricks, although perhaps not so compact as those made in Holland, are yet durable and strong, yielding a clear ringing sound when struck.

From the above mentioned particulars, we conceive that the means are furnished for understanding the reason of the peculiar properties of these bricks, and for imitating them to any required extent in our own country, and from our own materials. The first thing to be ascertained, is the constitution of the river clay—the Thames sand appearing to impart analogous properties, and having a somewhat similar origin, may be considered at the same time. The most obvious advantage of clay found in such situations, is its superior fineness of grain, for course sand or gravel is a disadvantageous addition to brick clay. We have then a mechanical advantage sufficient to account for the homogenous structure of such bricks. In regard to the chemical composition we unexpectedly met with a case bearing directly upon this inquiry in Pasley's able work on Lime, Cements, etc. The information is so much to the purpose that we trust our readers will bear with us while we enter into detail. Col. Pasley found that an excellent cement might be made by mixing chalk with the *blue clay of the river Medway.* He also found that this clay after exposure to the air became, first on the outside, and finally throughout, of a brown color, and having tried the clay thus altered by exposure, by burning it with chalk precisely in the same manner and in the same proportions as before, he ascertained that it had lost its excellent qualities. This put him upon examining into the constitution of the clay and the nature of the gases given out by it in heat-

ing. The result of an analysis by Faraday was that one hundred grains gave—

	Water,	50.9
	Sand,	14.0
Finer particles,	Silica,	14.8
	Alumina,	10.8
	Peroxide of iron,	3.4
	Carbonate of lime,	1.5
	Fragments of wood,	1.5
	Organic matter,	3.1
		100.0

Faraday remarks that the iron, although estimated as peroxide exists partly as a sulphuret and partly as protoxide. The gases given out by heating were such as would result from the decomposition of organic matter and sulphuret of iron.

It was suggested to Col. Pasley that the iron might be changed to peroxide by exposure, and that the addition of some organic matter might restore the clay to its former properties, and such proved to be the case. In fact, the small quantity of wood, etc., in calcining the mixture did in a measure produce the same effect, although perhaps not to the extent required for his purpose.

Now to make the application of this to the manufacture of brick we must remark that iron in the state of peroxide, either wholly or partially, (as it is found after long exposure) is incapable of forming a fusible compound with the other materials in clay, and these materials without admixture are incapable of forming a compound of any tenacity unless very highly heated. But iron, in the state of protoxide forms an easily fusible compound with the other ingredients of clay, and the presence of a sufficient quantity of wood, coal, resin, or other organic matter, will determine the conversion of peroxide into protoxide of iron. The finer and more intimately this organic matter is mixed with the clay, the more certain will be its effects and the less injurious will it be to the sound and homogenous appearance of the brick. In the fine river clay of Holland we have all these conditions fulfilled—the earthy particles are in a state of great mechanical division and mingled with them is a quantity of organic matter as finely divided. A small proportion of iron is present and when burned this is all reduced to protoxide which unites with the other constituents of the clay and forms a sort of slag or semi-vitrification which gives to the brick a very close and even structure. The length of time allowed for the burning and cooling, and the nature of the fuel have all a great effect in perfecting the article.

The English mode of manufacture gives an approximation to the same result. The Thames sand, exceedingly fine, and charged slightly with vegetable matter, furnishes the same advantages of minute division and a

favorable condition of at least a part of the iron. The addition of bituminous coal ashes, which contain a portion of combustible matter, helps to reduce more of the iron, while the other portions of the ashes are in no wise injurious, as they furnish still more earthy matter in a finely divided state.

As a confirmation of the above mentioned hypothesis, we find that *paving tiles*, which are made of a very fine clay well wrought and which is less refractory than ordinary brick clay, are rather stronger than the best bricks. In Holland the material for these tiles is also procured from the alluvial earth of meadows or swampy grounds.

It is evident, then, that to perfect the manufacture of brick, we must pay particular attention to the quality of the earth used, and when this is not precisely such as we wish, to improve it by the addition of other substances. The mud of rivers, when it contains sufficient clay, is probably the best material, and when deficient in this ingredient, it will only be necessary to add a proper quantity of some other stiff clay of fine texture, and not containing any coarse gravel. In order to imitate the yellow Dutch brick, it will be found useful, when river clay cannot be procured, to add to the best material accessible, a quantity of finely divided combustible matter. The substance best answering this description will be the finest anthracite coal dust, and we believe this has been used with success. This addition gives a double advantage—the conditions above named are fulfilled, and the fuel is not only applied externally, but also is furnished within and throughout the substance of each brick. It is also likely that the application of coal tar, or some similar resinous matter, would have a beneficial effect, where none but ordinary clay could be procured. The mud accumulated in the slips of our large cities could hardly be put to a better use than in brick making. It must be recollected that the presence of salt in quantities, is supposed to be injurious to brick clay. In the use of such mud or clay this must not be forgotten.

The experiments of Col. Pasley furnished us with some excellent trials of the strength of brick of various qualities compared with other building materials. In testing the cohesive power of the best cements he found that with bricks of good or even superior quality, the fracture in nearly half of the trials took place in the brick, and not in the joint. With inferior brick it was found impossible to carry on the experiment, as the cement proved the strongest. His testimony as to the cause of the inferiority of the bricks is so much to the purpose that we give it in his own words. "The weakest bricks now alluded to were *marle* brick of the very same earth as the strongest of the bricks that we had experimented upon before, made in the same field and under the superintendance of the same master brick maker. On examining the fractures of these weak brick it appeared that the ingredients, namely, brick earth with a small proportion of chalk to color it had not been so well mixed as in the others, for small white lumps of imperfectly ground chalk, were visible in many parts. This defect,

which was scarcely perceptible in the fractured parts of the strong bricks, cannot be discovered by merely examining the article."

We shall conclude with a table compiled from Col. Pasley's experiments, in which the vast range of the resistance of bricks cannot but be remarked. For the sake of comparison we add the strength of several other substances used in building, tried by him.

The prisms experimented upon were two inches square and four inches long, and were broken down by the application of a knife edge (from which a scale board was suspended) to the middle of their length. The average cohesiveness is deduced from the experiments in which the bricks were subjected to a tearing action in trying the different cements.

Description.	Weight of prisms in Troy grains.	Weight per cubic foot in lbs.	Breaking weight in lbs. in several successive experiments.			Average resistance in lbs.	Average cohesiveness in lbs.
Kentish rag	10739	165.69	4286	3817	5099	4581	3773
Yorkshire stone,	9571	147.67	2976	2500	3185	2887	3642
Cornish granite,	11164	172.24	3179	2801	2445	2808	3841
Portland,	9598	148.08	2195	2892	2958	2682	4004
Bath,	7945	122.58	708	694	596	666	1408
Plain tiles,	7154	110.38	1006 1189	1658 1225	764	1166	
Paving tiles,	7308	112.75	1148 1225	988 1188	1073	1124	
†Superior, bricks,	5944	91.71	704 955 722	795 622 706	617 640 823	752	3007
†Inferior bricks,			204	262	522	329	1105
Pure chalk, (dry)	6157	94.99	414	265	314	334	473
	Days old.						
An excellent artificial cement,	14	87.	560	468	442	490	1337*
Another,	15	83.	388 387	365 383	325	370	1453*
Sheerness cement,	15	104.	489	641	599	580	1220*

From the above experiments it appears that the *resistance* of various stones etc., in opposition to a breaking force, is not in proportion to their specific gravity, nor in any direct proportion to their *cohesiveness* in opposition to a tearing force.

For the American Railroad Journal and Mechanics' Magazine.

REMARKS ON THE "LAWS OF TRADE." By C. Ellet, Jr., *Civil Engineer.*

No. 2.

It was demonstrated in the article published in the preceeding number of the Journal, that the aggregate revenue of an improvement, derived from commodities of heavy burden of which the distribution is uniform, would be expressed by

* Adhesiveness to Portland stone. † These bricks were not of inferior quality as commonly denominated, but were all selected from the best made. The inferiority and superiority refer solely to strength.

$$R=\frac{t\Pi^3 c}{3\beta(\delta+c)^2}; \qquad (A)$$

and that when this quantity is a maximum c must be equal to δ, or the charge for toll must be equal to the charge for freight.

If we now make this substitution of δ for c, in equation (A,) we shall obtain directly for the value of the maximum revenue,

$$R=\frac{1}{12}\frac{t\Pi^3}{\beta\delta}. \qquad (B)$$

The tonnage due to the charge δ for toll, and the conditions imposed in the investigation, will be

$$T=\frac{1}{2}\frac{t\Pi^2}{\beta\delta}. \qquad (C)$$

By inspecting these two equations we will perceive that the *revenue* is directly proportional to the productiveness of the country, and to *the cube of the charge for carriage which the commodity will bear;* and that it is reciprocally proportional to the charge for freight on the line and on the lateral roads leading to and from it: while the *tonnage* is directly proportional to the productiveness of the country, and *the square of the charge which the commodity will bear*, and reciprocally as the cost of conveyance on the line and on its lateral branches.

We may form some estimate from these facts, of the influence exercised on the tonnage and revenue of public improvements by changes in the market value of the commodities carried upon them. If, for instance, they should penetrate a corn-growing district, where the value of corn in market exceeds the cost of its production, for any given year, 10 cents per bushel; and while the quantity raised per acre, and the cost of producing it, remain the same, the market value for the next year be increased 10 cents per bushel, then by equations (B) and (C), *the revenue will be increased eight fold and the tonnage four fold.*

Again, by comparing the preceeding expressions for the tonnage and revenue, we obtain the new equation

$$R=\frac{\Pi T}{6}; \qquad (D)$$

or, when the toll is properly assessed, the revenue derived from any commodity of which the distribution is uniform will be found *by multiplying the whole number of tons transported on the line, by the sixth part of the difference between the market value and cost of production of one ton.*

The difficulty of making correct estimates of the prospective revenue of a projected improvement is fully appreciated; but if the aggregate tonnage, and the charges which the objects expected to be conveyed will respectively bear, be first correctly assumed, the application of the formula will not mislead in the determination of the revenue. It is the practice of the patrons of new lines to fortify their arguments by such estimates both of the future tonnage and resources of their favorite schemes; and in such cases the formula may be used as a convenient test of the accuracy of their

conclusions. Let us suppose, for example, that we correctly estimate the wheat or corn that will pass along the work at 100,000 bushels; and that we know by experience that this article will bear a charge for carriage, to and along the line, of 30 cents per bushel. Then, by the equation, the revenue will be 500,000 cents, or five thousand dollars—and any estimate exceeding this sum should be viewed with distrust.

It is important to be able to anticipate what effect will be produced on the trade and profits of an improvement by deviating from the charge which we have ascertained to be that which will produce the highest dividend. It will be readily observed from the foregoing investigation, that if we exact a greater toll than the charge for freight, both the revenue and tonnage will be at once reduced; so that our solution furnishes a limit which must never be exceeded in assessing the toll on the class of commodities now under consideration. But, while it is very apparent that the charge can never exceed the value of the freight, without involving a loss of revenue, it is equally apparent that if it be less than the freight there will be some compensation for the diminished revenue in the augmented tonnage—and it might happen that the increased tonnage would be worth more than the revenue sacrificed to obtain it.

To determine this point, and ascertain the effect of such reduction, let us suppose that instead of a toll just equal to the freight, we establish for the charge but half that amount. In this case $c=\frac{\delta}{2}$; which value of c being substituted in equation (A) gives

$$R'=\frac{2}{27}\,\frac{t\,\Pi^3}{\beta\,\delta},$$

for the revenue due to the reduced charge. This value, compared with the maximum revenue, in equation (B), teaches us that by reducing the toll one half we suffer a loss of revenue of but 11 per cent.

The tonnage under the reduced charge will be expressed by

$$T'=\frac{2}{3}\,\frac{t\,\Pi^2}{\beta\,\delta};$$

which, compared with equation (C), shows that while a reduction of the toll of 50 per cent. reduces the revenue but 11 per cent. the tonnage is augmented by it 33 per cent.

Now, it will be remembered, that the tonnage is here regarded as proportional to the area of the country by which it is supplied; and therefore, in estimating the increase of trade consequent on any reduction of the charges, we estimate only that portion which is due to the increased area of country drained by the work; while the increased quantity furnished by a given area in consequence of the increase of the profits of the producer, are not reached by the computation.

That an augmentation of price will have the effect of increasing the exports from a given area, more or less, cannot be doubted; and we are therefore to regard 33 per cent. as the minimum limit of the increase of

freight to be anticipated from the assumed reduction of the toll, and 11 per cent. as the maximum limit of the simultaneous diminution of the revenue —limits which will never be attained. We are justified, therefore, in coming to the conclusion that *by reducing the toll one half, the freight will be increased more than one-third, and the revenue will be reduced less than one-ninth, of their previous values.* In fact the augmentation of the tonnage will be very important, and the loss in tolls, scarcely, if at all, perceptible. We may conclude from these facts, how very essential it is, where an uniform charge is adopted—a practice, however, which cannot be too highly deprecated—to make that charge on all commodities which escape the competition of rival works, exceedingly low. On long canals, where the average freight will be about 12 mills per ton per mile, the charges on nearly all the produce of the mines, fields and forests ought not to exceed 6, or at most 7 mills.

To the Editors of the American Railroad Journal and Mechanics' Magazine.

GENTLEMEN:—In looking over your valuable Journal of Sept. 1st 1840, page 154, this morning, we noticed for the first time, the following "we find it recorded that one of Mr. Norris' engines drew over the Philadelphia and Reading road, 54 miles, at the rate of ten miles per hoar, 101 cars, containing a nett load of 323 tons exclusive of cars and tender." As but in one instance has there been a train of 101 cars drawn over the road above mentioned, we think your statement ment to refer to an engine made by us, for the Philadelphia and Reading railroad Co., which in February last, drew over the road just mentioned a train of 101 loaded cars; the gross weight being 423 tons, of 2240 lbs. not including engine or tender: the nett weight of freight being 268½ tons, of 2240 lbs. This is much the largest load that has ever been conveyed over the Philadelphia and Reading road by a single engine, and when the weight of the engine is taken into consideration, being but 24,660 lbs. whole weight in running order, with full complement of fuel (anthracite) and water; on driving wheels 18,260 lbs. The performance may be looked upon as extraordinary.

Enclosed we send you the statement of Mr. G. N. Nicolls, furnished for publication in the Jour. Frank. Inst., at the time the above load was drawn, which gives a detailed account of the performance, which we respectfully ask you to insert, in connection with what we have written above.

Very respectfully,

EASTWICK & HARRISON.

Philadelphia, Nov. 2d, 1840.

STATEMENT OF THE PERFORMANCE OF THE LOCOMOTIVE ENGINE "GOWAN AND MARX," BUILT BY MESSRS. EASTWICK AND HARRISON, PHILADELPHIA, ON THE PHILADELPHIA AND READING RAILROAD, WITH A TRAIN OF ONE HUNDRED AND ONE LOADED CARS. FEBRUARY 20th, 1840.

Gross weight of train, including cars and freight, but not including engine or tender, 423 tons of 2240 lbs.

Net weight of freight, 268½ tons of 2240 lbs.

The freight consisted of—2002 barrels of flour, 82 do. whiskey, 459 kegs of nails, 19 tons bar iron, 22 hhds. meal, 5 do. whiskey, 4 do oil, and sundry other articles, making a total of 268½ tons.

Distance from Reading to the foot of the inclined plane on the Columbia railroad, 54½ miles. Running time of the engine with train, five hours thirty-three minutes; rate 9.82 miles per hour. Coal consumed, red ash anthracite, from Schuylkill county, 5600 lbs. Water evaporated, 2774 gallons.

Grades of road.—The total fall from Reading to the point where the train was stopped near the Columbia railroad, is 214.5 feet, being an average fall of 3.94 feet per mile. There is *no ascending grade* from Reading to the Columbia railroad, with the exception of about 2100 feet at its lower termination, graded at 26.4 feet per mile, upon which grade the train was stopped; the other grades vary from 19 to 15 feet per mile; there are only three miles graded at 18 feet and one at 19 feet per mile.

The total length of *dead level* line from Reading to the Columbia railroad is 27 miles and 4200 feet; of this the longest level is 9 miles and 500 feet long, between Norristown and the inclined plane; the others vary from 1550 to 4 miles and 1600 feet in length.

State of the track.—Owing to the frost coming out of the ground at this season, the track was in worse order than at any other time of the year; this, however, did not materially affect the performance of the engine, as the embankments were all in nearly as good order as at other times; and at comparatively few points in the deep cut, was the track sufficiently out of line or level to offer increased resistance to the train.

The superstructure of the road consists of a T rail, 45 lbs. to the yard, laid upon sills 7 feet long and 7 by 8 inches square, 3 feet 1½ inches apart from centre to centre, and laid on broken stone.

State of the rails.—For the first twenty miles the rails were in very bad order, the morning was cloudy, and a fog of the previous night had left sufficient moisture on the surface of the rails to diminish considerably the adhesion of the engine; for the remainder of the distance the weather was clear, and the rails in good order.

Working of the engine.—On three different occasions the engine started the whole train on a dead level, and when on a dry rail, without the wheels slipping.

The steam ranged from 80 lbs. to 130 lbs. per square inch, to which latter pressure the safety valve was screwed down.

The draught of the engine was created by the escape steam passing into, and from, a tubed exhaust box—no other draught was used while running; at the water stations, "Reilly's patent fan" was used when fresh coal was thrown on the fire, but at no other time.

The speed of the train was noted when passing through some curves of 819 feet radius on the 9 mile level, and found to be 9.8 miles per hour; on a straight line on the same level, the engine attained a speed of 10.5 miles per hour.

So little was the engine affected by her performance on the 20th, that on the 23d she drew, on her return trip, 88 burden cars, 9 of which were loaded, and a locomotive engine, making a gross weight of 163 tons of 2240 lbs., not including engine or tender, up a grade of 18.4 feet per mile. The train had a strong head wind against it during the whole trip, which owing to its length, 1206 feet, was sensibly felt at some exposed points of the road, and must have proportionably affected the power of the engine.

Weight and dimensions of the engine, "Gowan and Marx."—Weight

when empty 21,640 lbs. In running order, with fuel and water, 24,660 lbs., on four driving wheels in running order, or with water, fuel and two men, 18,260 lbs. Cylinders $12\frac{2}{3}$ by 16 inch stroke; 8 wheels, 4 of which are driving wheels, coupled, 3 feet 4 inches diameter; truck wheels 2 feet 6 inches diameter.

The weight of the burden cars averaged from 1.5 to 1.65 tons, of 2240 lbs. each; they were all 4 wheeled—wheels 3 feet diameter, and 4 feet 6 inches apart from centre to centre.

The above performance of an 11 ton engine, is believed to exceed any on record in this or any other country.

G. N. Nicolls,
Superintendant transportation, Philad. and Reading R. R.
Reading, Feb. 24, 1840.

English Engines.—We find the following performance in a late English paper:—

"*A long train.*—On Sunday morning last sixty-two carriages, containing 3200 passengers, and drawn by *four engines*, left the Leeds station for Sheffiield, and who returned again the same day—a distance of about 68 miles. This exceeds the other famous train which left Nottingham, a few days before, for Leicester, and which consisted of 57 carriages and nearly 3000 passengers, drawn by four engines."

How does this compare with the load drawn by *the American* engine on the Philadelphia and Reading railroad, at the rate of 10 miles per hour, allowing 150 pounds as the average rate of each passenger. One of Eastwick & Harrison's engines drew after it on the 20th of Feb. last, in a train of 101 cars, 423 tons gross, or $268\frac{1}{2}$ tons nett, at 2240 lbs to the ton, equal to 611,520 lbs. or 4,076 passengers.

On the *Boston and Worcester* railroad, where there are grades exceeding 30 feet to the mile, we find that one of Norris' engines drew the enormous load of 150 tons nett, equal to 2000 passengers.

Western Railroad.—England.—We perceive that this road has been in partial operation for two years and three months. During this period, the locomotive engines have traversed 29,000,000 of miles, and have carried 1,520,000 passengers, without a single accident. This road has a width of track of seven feet.

RAILROADS IN THE UNITED STATES.—By Chevalier De Gerstner.

(Continued from p. 281.)

RAILROADS IN VIRGINIA, NORTH CAROLINA, SOUTH CAROLINA, GEORGIA, AND FLORIDA.

The railroads in these States are nearly all of a light and cheap construction. They traverse sections of country only very thinly settled yet, and therefore command a very small traffic in the transportation of passengers as well as merchandise. It is, however, a particular advantage to these railroads that they form a better system than those in the other States, being nearly all connected together, and forming a great thoroughfare through a large portion of the Union; wherefore they are used by the

travellers from the north and north-west to the south and south-west, as also for the conveyance of the great southern mail. A continuous uninterrupted line of railroad, now exists from Fredericksburg in Virginia, to Wilmington, North Carolina, in the one, and to Raleigh, North Carolina, in the other direction; the former having a length of 304, the latter of 227½ miles. Within a short period, other lines of similar length will be completed.

The *railroads in Virginia* have all wooden superstructures with flat iron bars of small dimensions (generally ½ inch in thickness.) Their grades, however, are very moderate, the country being favorable for their location. The State government has taken an active part in the promotion of railroads in Virginia, by subscribing for two-fifths of the stock of all works, as soon as the other three-fifths were subscribed by private individuals.

The State of *North Carolina* has now two extensive railroads in operation, one of which forms the longest line of railroad as yet completed by a single company in the United States. The same railroad has an uninterrupted straight line of 47 miles in length. The width of track of the railroads in this State, as well as in the State of Virginia, is 4 feet 8½ inches.

South Carolina was in possession of one of the earliest railroads in America; but although this was completed in 1833, no other railroad has been undertaken, except the branch to Columbia, which forms the first section of the intended Louisville, Cinninnati and Charleston railroad.

The *Railroads in Georgia*, though but lately commenced, are beginning to class among the most extensive and important. When completed they will form a system by which the whole State must be benefited. One railroad is constructed by the State, the other lines were undertaken by private companies, to whom banking privileges are granted, in order better to enable them to raise the necessary capital, as also to realize a larger profit by the assistance of banking operations. The railroads are substantially built, partly with plate rails, and partly with heavy T rail.

The *Teritory of Florida*, with its small population, is not devoid of railroads; they are confined, however, to the western section of the country, where now three railroads with an aggregate length of 60 miles are in operation. They were constructed by private companies. A fourth railroad extending into the State of Alabama, has been commenced, but the works on it are at present suspended.

The railroads in Georgia, South Carolina and Florida, have all a clear width of track of five feet.

The following list of the railroads in the five States enumerated, has been compiled from data collacted during the summer of 1839. Corrections have been made concerning those works which have since been progressing, so that this table represents the different works in the state they were in at the close of the year 1839.

The number of locomotives in use upon 994 miles of railroads is only 102, being at an average one locomotive engine for every 9¾ miles of railroad, a circumstance which serves to indicate comparatively small trafic upon these roads. But the last column in this table at the same time shows that the cost of the construction of these railroads is samller in proportion, so that a moderate income will suffice to give a good interest on the capital invested. It must also be remarked that the charges for transportation are higher in the southern than in the northern States.

The average cost per mile of all the 23 railroads when completed, will be $15,644, according to the estimates of the Engineers, which in some cases may be exceeded; but even if a sufficient allowance be made for this, the average cost per mile will not rise over $16,000.

RAILROADS COMPLETED AND IN PROGRESS IN VIRGINIA, NORTH AND SOUTH CAROLINA, GEORGIA AND FLORIDA.

No.	Name of railroad.	From and to where.	Opened. Year.	Opened. Miles.	No. of miles. Besides graded.	No. of miles. Not yet constr'd.	Total length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion	Total cost of road.	Cost per mile.
1	Richmond, Fredericksburg, and Potomac,	Richmond to Fredericksburg and the Potomac.	1837	$61\frac{1}{2}$		14	$75\frac{1}{2}$	plates $2\frac{1}{4}\times\frac{1}{2}$	12 locomot's	1.200.000	250.000	1.450.000	19.205
2	Richmond & Petersburg,	Richmond to Petersburg,	1838	$22\frac{1}{2}$			$22\frac{1}{2}$	" $2\times\frac{1}{2}$	5 "	700.000		700.000	31.111
3	Louisa,	Richmond, Fredericksburg, & Potom'c r. r. to Gordonsv'le.	1838	35	14		49	" $2\frac{1}{4}\times\frac{5}{8}$	*	415.000		415.000	8.470
4	Richmond & Coal Mines	Richmond to the Mines.		12			12	" $2\times\frac{1}{2}$	*	100.000		100.000	8.333
5	Chesterfield,	Manchester to Coal Mines.	1831	13			13	" $2\times\frac{1}{2}$	horses	200.000		200.000	15.385
6	Petersburg & Roanoke.	Petersburg to Blakeley.	1833	60			60	" $2\times\frac{1}{2}$	12 locomot's	766.000		766.000	12.767
7	City Point,	Petersburg to City Point.	1838	9			9	" $2\times\frac{1}{2}$	1 "	210.000		210.000	23.333
8	Greensville & Roanoke,	Petersburg and Roanoke R. R. to Gaston.	1838	$17\frac{2}{3}$			$17\frac{2}{3}$	" $2\times\frac{1}{2}$	*	260.000		260.000	14.717
9	Portsmouth & Roanoke,	Portsmouth to Weldon.	1837	$78\frac{1}{3}$			$78\frac{1}{3}$	" $2\frac{1}{4}\times\frac{1}{2}$	7 locomot's	850.000		850.000	10.851
10	Winchester & Potomac,	Winchester to Harpers Ferry.	1836	32			32	" $2\times\frac{1}{2}$	5 "	500.000		500.000	15.625
1	Experimental,	Raleigh to Stone Quarries.	1833	$1\frac{1}{2}$			$1\frac{1}{2}$	" $1\times\frac{1}{4}$	horses	3.600		3.600	2-400
2	Raleigh & Gaston,	Raleigh to Gaston.	1840	$84\frac{1}{2}$†			$84\frac{1}{2}$	" $2\times\frac{1}{2}$	*	1.360.000		1.360.000	16.095
3	Wilmington & Raleigh,	Wilmington to Weldon.	1840	161†			161	" $2\times\frac{5}{8}$	11 locomot's	1.800.000		1.800.000	11.180
1	Charleston & Hamburg	Charleston to Hamburg.	1833	136			136	$25\frac{1}{2}$ lbs.	27 "	2.400.000		2.400.000	17.647
2	Louisville, Cincinnati, & Charleston,	Branchville to Columbia.			50	16	66	56 lbs.		800.000	800.000	1.600.000	23.880
1	Georgia,	Augusta to Madison and branches.	1839	$87\frac{1}{2}$	70	54	$211\frac{1}{2}$	2.4×0.8,46lb	10 "	2.178.000	1.000.000	3.178.000	15.026
2	Central,	Savannah to Macon.	1840	100†	30	63	193	$2\frac{1}{2}\times\frac{3}{4}$&32lbs.	4 "	1.280.000	1.020.000	2.300.000	11.917

* The locomotive engines used upon these railroads belong to other companies, with whom agreements were made for the purpose.
† These distances stated as opened, were completed early in 1840.

RAILROADS IN VIRGINIA, NORTH AND SOUTH CAROLINA, GEORGIA AND FLORIDA.—Concluded.

No.	Name of Railroad.	From and to where.	Opened. Year.	Opened. Miles.	No. of miles. Besides graded.	No. of miles. Not yet constr'd.	Total length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended	Amount wanted for completion.	Total cost of road.	Cost per mile.
3	Monroe,	Macon to Weston and Atlantic R. R.	1839	24	20	52	96	$2\frac{1}{4}\times\frac{5}{8}$	3 locomot's	600.000	900.000	1.500.000	15.625
4	Western and Atlantic.	Decatur to Ross' Landing.			100	40	140			1.400.000	1.400.000	2.800.000	20.000
1	Tallahassee,	Tallahassee to St. Marks and Port Leon.	1837	22	2		24	$2\frac{1}{4}\times\frac{1}{2}$	2 "	200.000		200.000	8.333
2	St. Joseph and Lake	St. Joseph to Bayou Colum-								120.000		120.000	15.000
	Wimico,	bus.	1836	8			8	$2\frac{1}{4}\times\frac{1}{2}$	2 "	500.000		500.000	17.544
3	St Joseph and Iola,	St. Joseph to Iola.	1839	$28\frac{1}{2}$			$28\frac{1}{2}$	$2\frac{1}{2}\times\frac{3}{4}$	1 "				
4	Alabama, Florida & Ga.	Pensacola to Montgomery.‡			15	$141\frac{1}{2}$	1 $56\frac{1}{2}$	$2\frac{1}{2}\times\frac{3}{4}$	2 "	600.000	2.400.000	3.000.000	19.169
				994	301	$380\frac{1}{2}$	$1675\frac{1}{2}$		104 loc'ts	18.442.000	7.770.000	26.212.000	15.644

‡ Only about 40 miles of this railroad are in Florida, the remainder in Alabama.

From this statement the following table is extracted, showing the number of miles of railroads undertaken and completed, as also the capital expended, and the whole cost of the railroads in each of the five States.

Name of State.	No. of railroads.	No. miles in operation.	Total length of roads.	No. of locomotives	Amount of capital expended.	Am't necessary for completion.	Total cost of railroads.	Average cost per mile.
Virginia,	10	369	341	42	\$5.201.000	250.000	\$5.451.000	\$14.772
North Caroltna,	3	247	247	11	3.163.000		3.163.000	12.806
South Carolina,	2	202	136	27	3.200.000	800.000	4.000.000	19.802
Georgia,	4	$640\frac{1}{2}$	$211\frac{1}{2}$	17	5.458.000	4.320.000	9.778.000	15.266
Florida Territory,	4	217	$58\frac{1}{2}$	5	1.420.000	2.400.000	3.820.000	17.604
	23	$1.675\frac{1}{2}$	994	102	\$18.442.000	\$7.770.000	\$26.212.000	1\$5.644

ON THE EFFECTIVE POWER OF THE HIGH PRESSURE EXPANSIVE CONDENSING ENGINES IN USE AT SOME OF THE CORNISH MINES. By Thomas Wicksteed, *M. Inst. C. E.*

I am induced to address you again* upon the subject of the engines used in the mines in Cornwall, from the very kind manner in which you received my last paper.

I have been lately into Cornwall, having been instructed by the directors of the East London water works company to proceed there for the purpose of examining an engine that was to be disposed of by the East Cornwall silver mining company, with a view of purchasing it for the company's works at Old Ford. The result was, that the engine, whose cylinder was 80 inches in diameter, was purchased, and is now being removed to London, and I expect that by this time next year, it will be at work here.

While in Cornwall, I was very desirous of making such a trial of one of the engines as might be satisfactory to the London engineers, and trust that I have succeeded in my object.

I received permission to make a trial of the engine upon the Holmbush mines near Callington, and beg to give you the following detailed account thereof.

The diameter of the cylinder was fifty inches; the sizes of the pumps or "boxes" as they are termed in Cornwall, and the height of the lifts are as follows: viz.

	Fath.	ft.	in.		
Tye lift.	42	2	6	Diameter of pump,	11 inches.
Rose lift,	37	5	6	Ditto.	11 "
Bottom lift,	8	5	6	Ditto.	10 "

The chief points to which my attention was directed, were the quantity of coals consumed, and the actual quantity of water lifted.

I saw 94 lbs. (a Cornish bushel) of coals weighed, and had the stoke hole cleared, and the coal bins and stoke hole doors sealed; and in addition to these precautions, besides my own observation, I had one of my young men stationed in the boiler-house during the time of trial, so that I am quite satisfied that no more than 94 lbs. coals were used.

Before the trial I ascertained exactly the length of the pump stroke, which was eight feet one inch, and caused the engine to work slowly that I might have sufficient time to measure the quantity of water delivered per stroke. The water was delivered into a wooden cistern, with a valve to let the water out when I had measured it. Finding that six separate measurements produced as nearly as possible the same result, the greatest variation being 2 per cent., I then weighed the quantity of water delivered by each stroke, and found it to be equal to 285 $\frac{6}{10}$ lbs. I had a rod made the exact length of the stroke, namely, 8 feet 1 inch, and during the trial measured the stroke frequently; it varied from 8 feet 1 inch to 8 feet 2 inches. I have in my calculations taken the shortest length.

The diameters of the pumps, and the exact heights of the lifts, were taken very carefully.

TRIAL.

The fire under the boiler was worked down as low as could be without stopping the engine. The pressure of steam was 40 lbs. per square inch *in the boiler*, I took the counter and the time, and then started the engine. At the end of 2¼ hours the fire was lowering, and the speed of the engine reducing, and it was necessary to have more fuel. The 94 lbs. of coal having been consumed, the engine was then stopped, and the coun-

* For previous communication see vol. 1, of Transactions, as published in this Journal.

ter again taken. It had made 672 strokes, or very nearly 5 strokes per minute. The weight of water raised was (285.6 lbs. × 672 strokes =) 191,833.2 lbs.; the height to which it was raised (was 42 fath. 2 ft. 6 in. + 37 fath. 5 ft. 6 in. + 8 fath. 5 ft. 6 in. =) 535 ft. 6 in. the weight multiplied by the height in feet is equal to 102,721,323 lbs. of water lifted one foot high with 94 lbs of coals.

This result, however, although it shows how much water was actually raised to the surface, does not show the duty of the engine, for although, in consequence of leaks and defective valves the quantity raised is not so great as it would be were it possible to have every part perfect, nevertheless, the engine has to raise the quantity due to the areas of the pumps, multiplied by the length of the stroke, under the pressure due to to the columns of water equal in height to the lifts, notwithstanding that in consequence of the defects mentioned, the whole quantity may not reach the surface; the fair mode, therefore, of calculating the duty of the engine, during the trial, would be as follows:—

	lbs.
Weight of column of water 11 inches diameter, and 42 fath. 2 ft. 6 in., or 254.5 feet in height,	10,498
Ditto. Ditto. 11 inches diameter, and 37 fath. 5 ft. 6 in., or 227.5 feet in height	9,384
Ditto. Ditto. 10 inches diameter, and 8 fath. 5 ft. 6 in., or 53.5 feet in height,	1,824
Load upon engine,	21,706

21,706 × 672 strokes × stroke $8\frac{1}{12}$ feet = 117,906,992 lbs. weight lifted one foot high with 94 lbs. coals.

From the foregoing it will be seen that 191,823 lbs. of water, were raised 535 feet 6 inches high with the expenditure of 94 lbs. of coals and that the duty of the engine was equal to nearly 118 millions of pounds raised one foot high. I should observe, that the engine had not been overhauled, or any thing done to it to prepare for the trial, which was not determined upon (as regarded the engine upon which the trial was to be made,) until the previous day. The boiler and flues had not been cleaned for eleven months. My object was to prove what could be done by an engine worked upon the expansive principle, and I therefore considered that a trial for two hours would prove the capability of the engine, although, most probably, the average duty of the engine for twelve months would not be so great as it was for the short time that it was under trial. I am perfectly satisfied the trial was a fair one.

I was not able to ascertain what the pressure of steam was when it first entered the cylinder, having no indicator with me; but the engineer, Mr. West, stated that the steam was wire drawn and reduced from 40 lbs. above the atmosphere, which was the pressure in the boiler, to 30 lbs. above the atmosphere upon entering the cylinder.

The steam was cut off at one-sixth the stroke. The steam in the jacket round the cylinder communicates directly with the boiler, and radiation is completely prevented, by the casing round the jacket; consequently a high temperature is preserved, which is absolutely necessary to obtain the full effect from the expansive force of the steam.

The following will show what effect could have been produced by the steam power, provided the engine and pump gear had worked *without* friction.

Pressure of steam when first admitted into the cylinder (30 lbs. + 14.75 lbs.—1.5 lbs. deducted for imperfect vacuum) = 43.25 lbs.

		lbs.
For $\frac{1}{6}$ of the stroke, the pressure was		43.250 per square inch.
When the piston had made $\frac{2}{6}$ of its stroke the pressure was reduced to		21.625
Ditto.	$\frac{3}{6}$	14.416
Ditto.	$\frac{4}{6}$	10.812
Ditto.	$\frac{5}{6}$	8.650
Ditto.	$\frac{6}{6}$	7.208
		6)105.961
Mean pressure of steam		17.66 lbs.

The area of cylinder was	1963.5 square inches.
Mean pressure of steam per square inch,	17.66 lbs.
Number of strokes,	672
Length of stroke in cylinder (being one foot longer than in shaft)	9 ft. 1 in.

Power of steam 1963.5 sq. in. × 17.66 lbs. per sq. in. × 672 strokes × $9\frac{1}{12}$, length of stroke, =211,658,702 lbs. raised 1 foot high with 94 lbs. of coals; now as the effect produced was 117,906,92, the friction of the machinery was eqnal to 93,751,710 lbs. raised 1 foot high, or about $7\frac{3}{4}$ lbs. pressure per square inch. As the friction of a water-works pumping engine is about $5\frac{3}{4}$ lbs. per square inch, it may be safely inferred, that an engine when working upon the expansive principle at a water-works will do more work than it does in the mines; to those who have seen the heavy pump rods, balance bobs, &c., attached to a mining engine, it will appear very evident.

In the observations I have had opportunities of making, I am very well satisfied that the engine I am about to erect at the East London water works will do a duty equal to at least 120 millions.

As it had been observed that the expansive principle would not answer for rotary or double engines, I was induced to make some observations upon a double engine working the stamps for breaking the copper ores at the Tincroft mines, and I beg leave to give you the details.

The diameter of cylinder,	36 inches
Length of stroke,	9 feet.
Length of crank,	3 feet 6 inches.
Steam was cut off in down stroke at	$\frac{2}{5}$ths.
Ditto up stroke at	$\frac{1}{3}$rd.
Number of strokes per minute,	10

The engine worked with a very equal velocity, in fact there appeared no irregularity whatever in the motion; Captain Paul, the agent of the mine allowed me to examine the coal accounts, from which it appeared, that the average consumption of coals for the engine was 30 bushel for 24 hours.

The engine was working—1st, a set of stamps: 2d, a pump; 3rd a crushing machine; and 4th, a trunking machine. The last two pieces of machinery had lately been added, and previous to this increase of machinery, it appeared from the books, that the consumption of coals was equal to 27 bushels, of 93 lbs. each, in 24 hours.

The stamping machinery worked 48 lifters; to ascertain the weight of them, I examined an account showing the weight of 26 of the cast iron heads when new, and found the average weight to be 3 cwt. 12 lbs. each, these are used until the weight by wear is reduced to 1 cwt. 2 qrs., the average weight will therefore be (3 cwt. 12 lbs. + 1 cwt. 2 qrs. ÷ 2 =)

2 cwt. 1 qr. 6 lbs. The weight of the wood work of the lifter, the iron straps, washers, etc., I found by trial to be 1 cwt. 3 qrs. 24 lbs., making the total average weight of the lifter and head (2 cwt. 1 qr. 6 lbs. + 1 cwt. 3 qrs. 24 lbs. =) 4 cwt. 1 qr. 2 lbs. or 478 lbs. The average height the stamps were lifted was 10 inches, and the 48 stamps were lifted 5 times per stroke.

The following calculations will show the duty performed by the stamping engine.

48 lifters × 478 lbs. × 0.833 feet, height lifted, × 5 times per stroke × 10 strokes per minute, × 60 minutes per hour, × 24 hours per diem, 1,376,089,-344 lbs. lifted one foot high in 24 hours.

The diameter of the pump was	14 inches, or 1.069 sq. ft. area
Length of stroke,	6 feet.
Stoke per minute.	10
Lift,	26 feet.

Duty performed 1.069 sq. ft. × 6 ft. × 62½ lbs. per cubic ft., × 26 ft. lift × 10 strokes per minute, × 60 minutes × 24 hours = 150,087,600 lbs. raised one foot high in the 24 hours.

DUTY OF ENGINE.

1,376,089,344 + 150,087,600 ÷ 27 bushels = 56,525,072 lbs. lifted one foot high, with a bushel or 93 lbs. of coals.

The single engine at the Holmbush mine, was, during the time of my experiment, doing the work of 26.48 horses; thus the experiment lasted 2¼ hours, or 135 minutes × 33,000 lbs., lifted 1 foot = 4,355,000 lbs., which would be lifted 1 foot high by the exertion of 1 horse's power in 2¼ hours. 117,906,992 lbs., ÷ 4,455,000 = 26.48 horses' power. The coals consumed were equal to 94 lbs. or (94 lbs. ÷ 26.48 horses' power ÷ 2.25 hours) = 1.57 lbs. of coals per horse's power per hour. The coals used by one of the pumping engines at Old Ford in an experiment lasting 1 hour, tried upon the 18th of February 1835, were equal to 4.82 lbs. per hour, per horse's power, or three times the consumption of the Cornish engine, notwithstanding the extra friction in a mining engine.

The double engine at the Tincroft mines was doing the work of 32.11 horses; thus 33,000 × 60 minutes × 24 hours = 47,520,000 lbs. lifted 1 foot high by the exertion of one horse's power during 24 hours. The engine lifted 1,526,176,944 lbs. 1 foot high in the 24 hours; 1,526,17,6944 ÷ 47,520,000 = 32.11 horses' power. The coals consumed were 27 bushels of 93 lbs. each, or 2511 lbs. ÷ 24 = 104.62 lbs. per hour ÷ 32.11 horses' power = 3.25 lbs. of coals per hour per horse's power.

Mr. Farey, in his valuable treatise on the steam engine, states at page 488, that a rotary or double engine of Bolton and Watt's construction, will require 10½ lbs. of coals per hour per horse's power, or three times the consumption of the Tincroft double engine.

The following tables may prove interesting; the first is a chronological table exhibiting the gradual improvement of the steam engine in the course of 66 years; (the first dates and quantities have been given to me by Mr. John Taylor;) the second exhibits the average duty performed by the engines in Cornwall in 1835 and 1836, including old and new engines and all sizes.

Mr. John Taylor, an authority that cannot be disputed, stated, in a lecture delivered by him to the members of the Society of Arts, that in 1829 he procured authentic accounts, from the consolidated mines, of coals purchased and used in 1799 and also in 1828; from Wheal Alfred mines of the coals purchased and used in 1816 and in 1825; from Wheal Towan mines of the coals purchased in 1814 and 1826; from Dolcoath mines of

the coals purchased and used in 1807 and 1817; and the result of his calculations, when comparing the depth of the mines at the different periods, the water raised, and the coals consumed showed, a saving upon the books of the mines proportionate to the improvements stated to have been made during these periods in the working of the engines.

TABLE NO. 1.

Date.	lbs. raised one foot high, with the consumption of one bushel or 94 lbs. of coals.	lbs. of coal per hour per horse's power.
1769	5,590,000	33.33
1772	9,450,000	19.70
1786 to 1800	20,000,000	9.30
1813	28,000,000	6.64
1814	34,000,000	5.47
1815	50,000,000	3.72
1825	54,000,000	3.44
1827	62,000,000	3
1828	80,000,000	2.32
1834	90,000,000	2.06
1837	97,000,000	1.91
Trial of Fowey Consols engine in 1835	125,000,000	1.43

TABLE NO. II.

Average duty of Cornish engines, according to Capt. Lean's Reports, 1835'6

No of engines.	Diam. of cylinder inches.	Average duty or lbs. raised 1 foot high with 94 lbs. of coals.	Average load on piston in lbs. per sq. inch.	Average No. of strokes per minute.	Highest duty or lbs. raised 1 foot high with 94 lbs. of coals.	Lowest duty or lbs. raised 1 foot high with 94 lbs. of coals.	Time of working, in months.
4	90	47,829,830	8.971	6.707	61,884,427	35,775,624	22
3	85	71,146,686	11.643	5.761	77,311,413	63,172,606	17
7	80	66,044,570	10.989	5.351	97,595,571	37,059,128	18
2	76	47,685,167	12.594	5.071	65,345,407	40,457,463	22
5	70	52,009,587	9.672	5.416	81,026,642	22,313,025	20
3	66	49,734,514	7.965	5.379	77,446,214	24,277,768	20
2	65	54,921,572	14.57	3.098	63,411,060	43,126,101	22
1	64	50,197,225	10.74	5.83	39,625,677	19,344,343	17
6	60	48,656,046	10.819	5.73	76,673,995	29,233,376	18
1	58	61,317,268	12.29	.945	67,115,413	55,366,495	12
1	56	38,059,440	12.826	3.452	46,509,910	30,656,541	8
1	53	44,468,465	16.	2.895	58,624,253	40,294,578	6
6	50	43,645,480	9.898	5.075	60,723,738	31,587,345	18
1	45	48,137,083	18.35	6.137	55,564,549	41,268,911	8
1	42	40,712,991	16.199	8.667	46,132,677	36,499.814	23
1	41	49,052,474	16.228	5.884	57,288,816	42,081,037	22
6	40	45,591,848	11.196	5.356	64,400,208	24,962.485	12
1	39	31,286,192	11.451	3.13	39,427,731	25,395,105	23
9	36	33,277,832	12 781	6.357	47,884,690	17,619,529	13
1	33	30,245,394	15.927	6,4	36,265,146	22,938,142	23
4	30	38,828,948	13.838	7.039	74,897,208	19,344,343	17
1	26	31,529,396	17.56	8.26	34,943,591	27,697,031	14
1	25½	28,248,292	17.6	11.555	32,431,160	20,773,914	23
3	24	35,377,387	13.682		47,101,689	20,562,859	21

I cannot conclude this paper without acknowledging the great attention I received from the intelligent engineers and captains of the mines in Cornwall, whom I found, as in my former visit, most anxious to give every facility to those parties who visit the country for the purpose of obtaining information; and notwithstanding their own thorough conviction of the advantages of the system they adopt, and of the truth of the statements made in the monthly reports, they were in every instance most desirous of removing the doubts that others might have, by permitting any trials to be made, and by most readily and openly giving any information that might be required.

THOMAS WICKSTEED.

Old Ford, August 7, 1837.

FOURTH ANNUAL REPORT OF THE PRESIDENT AND DIRECTORS TO THE STOCKHOLDERS OF THE L. C. AND C. RAILROAD COMPANY.

(Continued from p. 287.)

To those, however, who are reported as defaulters, but who are still most willing co-partners of the concern; who retain a confidence in the enterprise, and who value the interest they have in it, but who under circumstances unavoidable, and little anticipated, have not been able to meet punctually their engagements, the direction have felt under very great embarrassment how to proceed. Not insensible to the peculiar pressure of the money crisis, a pressure which strongly recommended (but for the binding obligation of engagements previously entered into by the company,) entire suspension of all work, until encouraged by more favorable times, measures of indulgence have been extended, as the advertisement of the secretary and treasurer, will show, to all those who will give their obligations by notes or bonds, where it is not convenient to pay immediately in cash; and the period of final settlement is now limited to the 15th of February next. The question is open for action on this subject, and the president and board of directors feeling sensibly the responsibilities connected with it, would refer to some declaration from the stockholders, the proceedings to be had against all those who at the time specified, may still appear as delinquents in the subscription book. It should be remembered however, that there is a class of stockholders, who embarked most liberally in the enterprise, who yielded probably to those appeals made on the occasion, and to which few were insensible; who more sanguine, and more confident possibly than others, could not forsee that reaction in the monetary affairs of the country, which has surprised every one; and who periled much, with the prospect now of losing all, who may merit some consideration. Plans have been proposed by which it was thought the measure of protection could be extended to them, and as one of these did receive the favorable consideration of both the local board of the road, and the board of directors for the bank, it is submitted, in the accompanying programme, for any action the stockholders may think proper to recommend.

It may be here stated that there are no circumstances operating more prejudicially on the value of the stock of the company, (and with its depreciation in the market is unavoidably effected both at home and abroad, the credit of the company,) than the undefined relations of the supposed stockholders, and the uncertainty *as to the number of legitimate bona fide share owners;* those who acknowledge their obligations, feel an undiminished interest in the concern, and who through good, and through evil report, are still willing to endorse or stand by it. The most important, and salutary measure of the company, would be the removing, as speedily as

possible, all doubts on this subject; and if even affected at the seeming concession of a portion of the more fortunate stockholders, they will reap the advantage in the enhanced value, which, by the diminution of the number of shares, will be given to those retained.

In pursuance of the spirit of the resolution introduced by Mr. Woodfin, the secretary and treasurer, has been instructed to keep the funds of the different states, so far as collected and reported to him, separate and distinct; appropriating to the construction of the road to Columbia, the funds only collected from the South Carolina subscribers. By resolution of the board of directors, the president of the branch of the south western railroad bank, at Knoxville, was constituted the agent of this company to receive the monies paid, and the bonds and interest thereon, of the Tennessee state subscription; and an arrangement was effected with the mother bank at Charleston, for the allowing of an annual interest on a deposite of the same at the rate of four per cent. per annum. The whole to remain as an accumulating fund, for the benefit of the road; and to be applied on its construction, when it shall be deemed advisable to commence operations within the limit of that state.

With regard to Kentucky, there has been no action on this subject. If any collections have been made from the subscribers in that state, the amount must remain unreported, in the hands of the commissioners. Mr. Woodfin's resolutions, however, were limited to the state of North Carolina, and if intended to be extended, as in justice they should, to the individuals in the other states, parties to the concern, it is incomplete, and particularly in relation to the disposition of the notes; the resolution being silent as to whether they should remain deposited with the directors in that state, or with the treasurer of the company. Without the latter, or some evidence which may be recognised by the officers of the bank as an authorised payment, or security of payment on instalments on the road, the North Carolina stockholders, with those of the other states, under a resolution of the bank, may be embarrassed in the collection of dividends on their bank stock.

A separate statement of the expenditures in each state is likewise directed to be kept, and made chargeable against the state funds respectively. As yet no expenditures have been made beyond the state of South-Carolina, but for surveys; the engineer, therefore, has been instructed to apportion accordingly, the sums expended by that department in each state, to be charged hereafter against the sections of road within the limits of the same.

The relations of mutual confidence existing between the company, and their bankers in London, and which had been temporarily interrupted, by a misunderstanding of the obligations supposed to have been imposed by the agreement made with them and our agent, as explained in the report made by Mr. King, has been restored by the polite intervention of Messrs. Baring, Brothers & Co., to whom, with the consent of both parties, the points of disagreement had been referred. Though your board has most cordially acquiesced in the opinions of that most respectable umpire yet the fact is not to be disguised, that the depreciation, at which a portion of the second million of the South Carolina loan was sold, together with the incidental expenses for negotiation, &c., must result in a loss to the company chargeable on the cost of our enterprise. As it was apparent however, that the depreciation of American stocks in the European market, and by which this company had been a sufferer, originated full as much in distrust, from the non-compliance on the part of some of the States with their obligations, as from the sudden and unexpected revulsion in trade, the earliest measures

were taken to remit from the proceeds of the Hamburg road, the amount necessary to liquidate the semi-annal interest on the bonds negotiated up to the 1st of July last; and to show, from copies of the semi-annual reports on that road transmitted, the pledge which has been made for the faithful performance, on the part of this Company, of the liabilities contracted in its behalf by the state of South Carolina. It affords us pleasure to state that this prompt action, has not been without its salutary influence; and that while Messrs. McKillop, Dent & Co., have extended every indulgence for the advances made on the drafts of this company, predicated as it appears by mistake on a deposit of state stocks, they have continued to act with liberality in not forcing sales, but in disposing of the bonds in small amounts as a demand in the market was created; and at rates which will compare with the most favored stocks of the same description in the London market. Their demand against the company is thus gradually diminishing, and as the amount of bonds in deposit, exceed even at a great depreciation, the sum for which they are in advance, there will be no necessity it is hoped for the diverting of any other fund to the extinguishment of that portion of this company's existing liabilities abroad.

The committee appointed to consider the communication of Mr. Trautwine, have stated verbally to the directors, that the action of the legislature of Tennessee, at its last session, preclude the necessity of any report on the subject referred to them. A deputation however, from Tennessee, have submitted a memorial, embracing the same objects, and which will require a response from this company at this annual meeting.

ROAD TO COLUMBIA.

The report of the resident Engineer on the operations on the road, as far as Columbia, affords the requisite information as to its progress, probable cost, &c. From the Tabular statement accompanying the Report, and which has been prepared with great care, we collect the following facts: That the entire cost of the road between Branchville and Columbia, when completed, will not fall short of the sum of $1,816,724 8.

Thus explained in detail:

Value of embankments, masonry and other work done, and materials which have been furnished and paid for,	$926,688 08	
Value of the same finished and furnished but not paid for, and held in reserve as security,	72,549 36	
Value of embankments and other work yet to be done, and materials to be furnished, iron rails, &c.	692,486 46	
Engineering instruments, office expenses, &c. paid for,	85,000 00	
Contingencies,	40,000 00	
		1,816,724 08
Leaving to be provided for,		805,036 64

In a communication published shortly after my being charged with the administration of the affairs of this Company, I assumed two millions of dollars, as the sum which it would be necessary to provide to meet all the liabilities for the construction of the road to Columbia. The resident engineer's estimate is somewhat below that amount, but as he has not included the cost of the right of way, and many other incidental expenses, which it is difficult to embrace with accuracy, even the item of contingencies, the

company will find that two millions is not too large a sum to appropriate from their capital, as the proportion necessary to complete the road as far as Columbia. The most intricate and heaviest work on the road, along the entire line from Columbia to Branchville, a distance of 66 miles, had been put under contract a year or two since. Some of these which were indefinite verbal agreements, were recently brought into written form; and no new contracts under the present administration have been entered into, but for the completion of a building, turn out, &c., necessary at the depository, at Orangeburg, and for the timber, superstructure beyond that point as far as the state road. Proposals were elicited for the supply of mudsills, cross-ties, &c., necessary for the whole distance; but as from the terms of the contracts, some of the embankments could not be completed as early as was desirable, it was deemed advisable to suspend entering into any further obligations until the state and progress of the work would warrant it. In the meanwhile measures are taking to ascertain the lowest rate at which the materials required may be obtained, and whether the road, as finished, may not be brought advantageously to our aid in diminishing their cost.

* * * * * * * *

The two last semi-annual reports, for January and July, 1840, by the president and direction of that corporation, you are respectfully referred for the most ample and satisfactory information of the state and condition of the road as far as Hamburg; and its operations for the last half year of 1839, and the first six months of the year 1840. In a brief address, hastily prepared to the stockholders of the Louisville, Cincinnati, and Charleston railroad company, on entering on the administration of its affairs, as President in March last, I estimated the probable receipts for this year on that road at $470,000, and the expenses $320,000, leaving a nett profit for twelve months of $150,000 for the half year. Mr. Tupper exhibits the actual receipts for the first six months of 1840, at $223,295 46, the expenditures at $152,213.80, and the nett income at $71,086 66, differing from the estimate only in the sum of $3,981,44. When the embarrassed state of the country is taken into consideration, the entire stagnation in all trade, domestic as well as foreign, and the almost complete suspension recently of that locomotion from north to south, as the seasons change, so peculiar to American communities, stimulated alike by commercial enterprise and social feelings, our astonishment should rather be that the results approximated so nearly to an estimate based on past prosperous events, than that they should have fallen short. The estimate, however, being for the whole year; the revival of a fall intercourse and trade, equal to that participated in the last season, of which there are encouraging indications on the commercial horizon, may yet so augment the receipts for the last six months, as to realize fully the expectations of that address. The most gratifying exhibit in the report, is that "the accounts continue to show the pleasing fact of an *increase* of *income*, while the expenses *continue* to *decrease*.

It is a subject therefore of congratulation, to report that the system of economy of expenditure which had been recommended, is now maturing as rapidly as circumstances will probably permit, and that the present direction, seconded by most willing and competent officers and agents, have in the last year's management fully realized the expectations of the investigating committee instituted by this board, in bringing down the expenses of the road a fraction below 70 per cent. of its receipts. The additional fact is presented of the annual expenses of police, and reparations having been reduced to $412 per mile, which is creditable to the activity and intelligence of the superintendant, and must stimulate him still further in the work of retrenchment, as in a previous estimate he had placed these charges at

$525 per mile, with an expression of opinion that they might be brought to $500, but probably not much lower. The annual cost of the maintenance of way in the different railroads in the United States, and in Europe, varies very much. In England and Beligium it is from 45 to 60 per cent. on the receipts, in this country the variations are greater; the expenses on the Georgia road, a railway, however, most of which is new, has not the last year equalled 40 per cent. while on many of the other roads, particularly in North Carolina and Virginia, they amount to 60 or 70, and even 80 per cent. The general average, however, was estimated by our investigating committee at 60 per cent., and if to this standard the expenditure on the Hamburg road could be brought, (of which there is every prospect,) the nett profit on the present annual receipts, without any addition, would be augmented to 9 per cent. upon the original capital, and full 6 per cent. upon the cost of the road to this company.

In the progress therefore, of a more approved system of accountability, and economy now gradually introduced, the company have every guaranty that its affairs will be administered as will best advance its interests without jeopardizing the good condition of the road, and we feel convinced that the practical and indefatigueable gentlemen who directs its concerns, will, in his further investigations and exertions, on this all important subject, review the opinions he has expressed, and arrive at the conclusion we have, that in no department may the hand of retrenchment be more *certainly, more judiciously*, or more *advantageously* applied, than on the large amount of labor nacessarily employed for the maintenance or preservation of the road. To convert labor into capital, as it is every where successfully used in the southern States, and to substitute labor *thus owned by the company*, for slave labor now hired at remunerating prices from private individuals, is an operation, so far as economy merely is consulted which cannot require exemplification.

There are about 144 laborers reported as employed in the various departments on the road, at from 15 to 16 dollars per month. The number of engines in constant use during the business season of the year are 12, requiring two firemen, involving a charge, where white men are employed, as has been the case in some instances, for 24 men, at $1 per day each. When the road to Columbia is finished, the number of hands which will be necessary to attend to reparations, service at depots, on engines, etc., cannot fall short of, and will most probably exceed 200 individuals along the line of both roads; involving a monthly expense, at present rates, for pay of $3,000 or an annual charge of $36,000; which sum alone will be equal to 8 per cent. upon the present receipts, and about 1 per cent. on the whole capital involved in the construction of the road. Whatever objections may seemingly be justly entertained, by many as to the application of black or slave labor to the mechanical operations connected with the road; even that remains a problem to be exposed to the test of further examination and experiment, before we could yield to the considerations which have influenced others to condemn it. The policy however, of substituting labor owned by the company in the ordinary work on the road, for labor hired from individuals is very different; and we are so prepossessed in its favor, that the subject, as involving an increase of capital invested, is now seriously presented to the consideration of the stockholders. As an expedient to diminish expense, and consequently in the Franklin philosophy, to increase profits, it does not require an argument; but as a measure of *permanent policy*, insuring a more certain and steady control of all in the service of the company, and thus a more regular and efficient system for the management of the road, it stands recommended by the most imposing consid-

erations. Villages of farms could be distributed at the most convenient points on the line of road; the greater comfort of the slaves and their families attended to, WHICH OWNERSHIP IS KNOWN INVARIABLY TO IMPOSE; and the labor so selected and distributed, according to the talents developed, or the ascertained qualifications of the persons, as would most certainly secure the faithful performance of that which was to be executed. Labor thus tutored, and confined to, and growing up with, and on the road, would create an identity of interest, and feeling between the slaves and the enterprise; the former seeing that on the success of the latter would depend the permanency, and greater comfort of their own situation. Slaves who are now owned by the company, are reported by the superintendants and overseers, as efficient, as faithful, and as manageable as those hired, and it is difficult to conceive the reverse, as their condition is the same, the master only being changed, and the slaves always fare best when in the service of his own master.

Economy of construction, and in the management of railways, is a subject of as much interest to the community as to the proprietors. It enables the latter, without diminishing their profits, to cheapen both the cost of transportation of merchandise and of passengers. On the latter subject there is now a feeling adverse to the increased charge on passengers between Charleston and Hamburg, authorised by an act of the South Carolina legislature, and it is very questionable how far the higher rates now exacted have contributed to an augmentation of income. The reports show 4,000 passengers less this, as compared with the previous year, and the reports on the Georgia road exhibit nearly the same deficiency. Although many causes have conspired the last year, to interrupt travelling, yet as the fact is well known that on other main avenues of communication between the south and the north, the rates have been greatly diminished; it is not so certain but that these causes, with our increased charges have had an influence in diverting travellers from the Augasta and Hamburg road in other directions. The profit of a railroad, and it is peculiar in this respect, depends much more upon the quantity of freight and travel on it, than upon the higher or lower change for transportation. This may be so excessive as to exclude both, and then it may be so low as to preclude any profit. The happy medium to accommodate, and encourage all interests, is the desideratum to be sought. To a certain extent, reduction of the cost of freight and travel, does stimulate to increase of receipts and of income. Thus it has been ascertained from calculation, that a locomotive, with power to convey 200 passengers, can traverse a railroad at the cost of $1 per mile, or half a cent to each passenger, provided the whole number could always be obtained. Two hundred passengers, therefore, at $5, or even $3 to Hamburg—one-half, or even one-third of the present charge would be more remunerating to the share owners than the present daily average of some 25 or 30 passengers at $10 each. The locomotive has to perform the trip however, daily, whether a greater or a less number of passengers offer, and thus a certain expense incurred on a doubtful result. The point on which freight and passage, however, should depress or be fixed, so as to accommodate and compensate all interests concerned, depends so much upon locality, population and other causes and circumstances, that it will require both experience and observation to ascertain the limit to which falling, the trade and travel of the country would be sufficiently stimulated so as to increase receipts without reducing income. In southern countries, scarcely populated, and where the neighborhood travelling must be limited, and cannot be greatly increased, under any circumstances, or additional inducements for travelling offered, this problem is

most difficult of solution. The present income of many of the southern roads, even at the rates complained of, is only in a few instances, greater than their expenses, and in Virginia charters have been amended, so as to allow of increased charges for freight and passage to sustain their roads.

These are intricate subjects which time and experience alone can enlighten. The community of South Carolina, however, enjoy a guaranty from all possible imposition in the fact, that the dividends on the Hamburg road, under the higher tariff of charges, are limited, and that whenever, therefore, reduction of charge for freight, or passage, will stimulate to an increase of, both it is unquestionably the interest of the company to fall in their rates; and therefore, as a subject intimately connected with the prosperity and sncccss of the road, it will continue, as it has, to engage the attention of your direction. It is the judicious management, not ownership of property, which gives value to it, and railroad, like real estate, and the planting interests of the south cannot be found exempt from this general rule. As interests, however, in the hands of companies, and of corporations, are not, (possibly cannot) be invariably watched with that instinctive eye which individuals cast on their private concerns the greater vigilence and intelligence becomes necessary in the supervision and direction of the various departments on which devolve the management of the co-partnership. In the south, however, we have many difficulties to contend with, and to a certain extent, we must be guided by our own acquired, and cannot profit always from the experience of others at a distance. Our intentions and our modes of operating are peculiar, and therefore we cannot invariably rely on systems of police and economy, which have been most approved elsewhere, but under a different organization of society, Under every view therefore, of these important subjects, connected with the company's relation to other, as well as their own interests, we rather incline to the opinion, that the annual expenses of the road will be found susceptible of further advantageous modifications; that in none can a more favorable change be made, than in the *substitution of labor owned by the company* for labor hired, and that some reduction of the present rate for passengers on the road will be found highly advantageous to those who pay, as well as to those who receive.

The receipts for the transportation on this road exhibit an average annual increase of about 21 per cent. and which, it is believed, it will maintain for many years to come, and probably progressively improve as the roads through the interior of Georgia, and the south and west are completed. As disastrous as the last season has been to the trade of the country, the report of the agent of transportion shows an increase in both the up and down freight, with the still more important fact that an intercourse now partially commenced with Tennessee has contributed to this excess. In the report of the chief engineer on the Georgia railroad, there is a similar statement, which is encouraging, as showing that already have the citizens of Tennessee been attracted to these new southern railroad avenues, now in progress of construction to the west.

The report and income of the road, as being above 7 per cent. is based on the old capital of the South Carolina canal and railroad company of two millions of dollars, the amount which had been paid in and divided into 20,000 shares of $100 each. Of these the Louisville, Cincinnati and Charleston railroad company, have already become the purehaser of 19,877 shares, at a premium nominally of 25, but actually of but 20 per cent. As, previous to the transfer, the old direction of the company had appropriated without declaring any dividends, most of the receipts on the road to its improvement; to the purchase of nroperty at a depreciation, and which

had greatly enhanced in value, and of motive power, and to the establishment of depots, work shops, and the purchase of machinery; the road and its appendages, were, on examination, and a just estimate, deemed intrinsically worth the par value, with the premium paid. In addition to this, the completion of the embankments which had been determined on, and which had been but partially finished on the transfer, the heavier new flange rail which had been substituted for the flat iron bar, all involved further expenditures, which became necessary to place the road in the improved condition in which it is at present, and which was demanded by the increasing trade, and travel on it.

Estimating all these expenditures therefore, as capital invested, as it was only by calls for instalments on the stockholders, that they can be finally liquidated, we assumed, in a former communication, three millions of dollars, as the capital required to pay the cost of purchase of the South Carolina canal and railroad charter and road; and to meet all the liabilities and expenditures for necessary additional improvements; and it is believed that sum will not be found more than adequate to all the objects to be accomplished.

The cost of 19,877 shares in the Hamburg road, including advances for railroad iron, etc. from the exhibit of the secretary and treasurer, is,	\$2,877,534 90
Add to this the amount due the State and interest,	138,223 59
Cost of road to the L. C. & C. R. R. Company,	\$3,015,758 49

(To be continued.)

THE STEAM FRIGATE.

As much desire is apparent in the city to know something definite in regard to the progress to completion of this vessel; we, with the laudible desire of allaying such curiosity, wended our way some days ago to the scene of operations, the Navy Yard. As we neared the building containing the vessel, the busy hum, and cheerful sounds of industry broke pleasantly on our ear—mixed and blended came the sounds of the grating saw, the hammer's clink, the fall of heavy timber, and the stroke of the axe, as each of the multitude engaged on the vessel, plied his separate avocation. Having entered the building we turned our admiring gaze towards the huge vessel whose enormous proportions were spread out before us. Having walked down the large space in order more fully to view her beautifully modelled shape; we, mindful of the cravings of our readers, turned our attention to obtaining requisite information, and by the kindness of some of the gentlemen connected with the yard, we are enabled to lay forth the following particulars:

The frigate is built in the best and most durable manner of live oak obtained from the southern part of Georgia, and weighing 80 pounds to the square foot. The frame of the hull is supported in the strongest manner with live oak knees, etc., and in regard to bolts and fastenings of every kind, nothing but copper has been employed. She is double decked, the space between them being a little more than six feet, and in the centre of the vessel is a large space for the reception of the engines, at each end of which there is an iron plate bulk head or screen drawn completely across the vessel for the purpose (in case of a leak) of keeping the water in one part of the vessel, and also to guard against accidents from the fires of the engines. They are at this time planking the upper deck, and the whole vessel is in such a state of forwardness that (were the engine ready) she could be launched in two months. She will be rigged in the same man-

ner as a ship and will require as her complement two hundred men. Her ordnance will consist of forty-two pounders and two bombs to throw ten inch shells—and when in full sailing order her burthen will be 1700 tons. Her weight is estimated at 500 tons. She is nearly as long as the steam ship President, and one foot wider. In her hold is constructed a repository capable of containing 800 tons of anthracite coal by which the engines are to be worked. In regard to to the principal dimensions, we have obtained the following:

	ft.	in.
Length from the counter to nightheads,	228	8
Extreme length to figure head,	244	
Extreme breadth,	40	
Depth in hold,	23	6

She will be ready for caulking in a few days. Taken as a whole, this vessel is a splendid specimen of the skill of our artizans. No one should neglect to view so noble a testimony to the already high character which Philadelphia has attained for ship building.

Leaving the scene of busy industry, we wended our way to another and more noisy scene—the engine and foundry establishment of Messrs. Merrick and Towne, who are busily engaged in making the engines for the Frigate. Having obtained permission we wandered through the large establishment, which is filled with workmen, who in pursuit of their several occupations made noise enough to have awakenad the seven sleepers. In the first room we entered a number of workmen were engaged in filing and polishing various parts of the huge engines. The main centre-pin for the lever beams weighing about 500 pounds was in the process of being turned, on a very large lathe. The steam chambers, specimens of great skill in casting, being of a very intricate shape and cast in a single piece, are very nearly finished—a huge cylinder more than 6 feet in diameter and at least 12 feet high was being bored—this machine for boring is of a new construction, the body to be bored being placed upwright instead of being laid down as usual—the circle of the bore is more true, it having been found that by the old method the bore was not exactly circular. We also observed a very neat machine for making screws; all the workmen in this room were engaged on articles for the frigate, and the beautiful finish on the brass and steel work, is deserving of all praise. In the next room are a number of large forges the blast of which is derived from a large fan-wheel driven by a steam engine. A small vertical trip-hammer, capable of fagotting a bar 6 inches square, was in operation as we entered, and was rapidly reducing to shape a large mass of glowing iron.

The foundry next attracted our attention. The mould of one of the frames of the engine was very nearly ready for casting; outside the door was a frame which had been lately taken from the mould; it weighs about 12 tons, and is of a beautiful Gothic pattern. The castings which we saw are very heavy and very difficult, and the success which has attended Messrs. M. & T., in their efforts thus far, is great evidence of skill and superior workmanship; a large number of castings varying in weight from one to twelve tons are in process of finishing here.

The next place to which we bent our steps was to the boiler room, where are four large copper boilers now nearly finished. At the upper part of building one of the engines is being put up together. The following are the dimensions of some of its parts.

	ft.	in.
Diameter of cylinder,	6	4
Length of stroke,	7	

Bed plate, weight 14 tons, with channels cast on,	length,	29	2
	breadth.	7	4
Main shaft of wrought iron,	diameter,	1	5
	length,	25	8
Paddle, wheels entirely of wrought iron,	diameter,	29	8
	the bucket,	10	0

Weight of steam cylinder 8 tons, weight of bed-plate 14 tons and 36,000 pounds of metal used in the melting.

These engines are of the kind usually known as the English marine engines. The cylinders are placed vertically, with two lever beams, one on each side, working on pedestals rising from the bed-plate and connected over the cylinder with the connecting rod by side links.

The Gothic pattern which has been adopted is very handsome and appropriate. They were commenced in January of this year, and will be finished in the spring of 1841.

We view with gratified feelings these substantial monuments of the skill and industry of the mechanics of our city. Our city has long held an enviable reputation for manufactures, and each succeeding day but serves to add to it. The light of intelligence is shedding her cheering beams around our artizans, and on the daily, nay hourly improvements which they exhibit, Philadelphia builds her proud and honest fame.—*U. S. Gaz.*

THE WAR STEAMER AT BROOKLYN.

Responsive to our request, an attentive friend at the Brooklyn Navy Yard, has furnished us with some very acceptable information in relation to the war steamer now in progress at that establishment, and which will shortly be launched into her destined element.

Her length from figure head to taff rail, is	243	feet.
" On upper or main deck,	223	"
" Between the perpendiculars,	220	"
" Of keel at the bottom,	207	"
Breadth of beam over the wales,	40	"
" Outside of the wheel house,	66½	"
Depth from main or upper deck,	23½	"
Measurement as a double decker,	1700	tons.
Measurement as a single decker,	1940	"
Measurement by the same scale as the tonnage of the President is estimated,	2275	"
Diameter of the glenders,	60	inches.
Length of the stroke,	10	feet.

The engines are about 600 horse power, and space is provided in iron bunkers, to carry 800 tons of anthracite coal, which it is intended to consume.

Inclination of the engines,	25 degrees.
Diameter of paddle wheels,	28¾ feet.
Length of the paddle,	10 feet.

There are four iron plate bulkheads, to divide the ship, so as to insure greater safety in case of springing of a leak, so that although one apartment may be filled with water, the others remain free.

The steamer is the same in shape, form and finish as that in Philadelphia, with the exception of the engines, which are purely and essentially American, being on the inclined principle, and as far as they are finished, they promise to be the *ne plus ultra* of engines.

This plan for the engines has been selected with a view to testing their

applicability to naval purposes, and should it succeed as well as there is now every reason to believe, the same principle will be adopted to future war steamers.

Of the beauty of the model, and the admirable finish of the internal arrangements, I will not now speak, for, as she will soon be launched, those desirous of beholding one of the most perfect specimens of naval architecture, will doubtless visit her and judge for themselves.

It has not yet been determined what is to be the nature of her amount, but it will no doubt comprise, among other guns, at least two of the celebrated Paixham guns, for throwing hollow shot.

The decks are laid, and her hull is nearly calked, and coppered to the light water mark, so that if nothing unusual occurs, she will be launched in about four weeks.

Very many nautical and scientific gentlemen have already visited her, and unfinished as she is, she has been pronounced to be as fine a model as ever was conceived; and from the solidity and faithfulness with which she is constructed, she bids fair to stand a pretty considerable battering.

It would be hardly fair to close this brief notice of this beautiful vessel without paying to Samuel Harth, Esq., Naval contractor of the Navy Yard, who superintends the whole building, a tribute to those scientific attainments so eminently possessed by him, which have suggested and consummated some of the most important and valuable alterations and additions to the plan as originally conceived.—*Sun.*

The following is an additional proof, that moderate fares increase and extend the business, *produced by railways.*—

Liverpool and Manchester Railway.—In the appendix of the 5th report to the British Parliament, pp. 371, 372, and 373, we find the following:

	1837.	1838.
Special agreements,	18,294*l.*	31,906*l.*
Passengers and parcels,	126,287	124,193
Goods,	81,419	104,204
Total,	226,000*l.*	260,330*l.*

The passenger's fare was raised 6d. for the whole distance of 31 miles, on the 25th of November, the passengers, after this rise, fell off 1 1-2 per cent., and they also fell off the amount of annual natural increase, viz: 10 per cent. *showing a loss by the higher fare,* of 11 1-2 per cent.

It is to be remarked, by the above statistical account, that, during the very same time when the passengers thus fell off, the receipts under special agreements, (which approximate to the nature of tolls,) increased 74 per cent. and the receipts for freight increased 28 per cent.

Sunday at Versailles.—The Presse de Seine et Ooise, states that on Sunday last, when the waters played at Versailles, the officers for the distribution of tickets were quadrupled, so as to enable the railway company to give out 1000 tickets in twelve minutes. This arrangement enabled the company to send off every half hour, between six in the morning and ten at night, several trains of 25 to 32 carriages each, some of which were drawn by four engines. The service continued until midnight, but the arrangements were so complete, that their remained only a few persons to return after ten. In the course of the day 1750 carriages were sent along the line, being equal to 3500 diligences of twenty places each. To

have conveyed this number of persons, would have required 14,000 horses, estimating each horse to perform six leagues during the day.—*Galignani.*

Central Railroad.—We refer with State pride, to the progress made on this road: one in which all the citizens of Georgia, and more particularly the citizens of Savannah, are so deeply interested. Contracts for grading will be concluded at Milledgeville early next month, to the upper terminus of the road, which will be another rapid stride to its completion, and the receipts on the road thus early, should nerve all friends of internal improvement in the legislature, to battle for railroads and canals, and not permit any lukewarmness on the part of any who have heretofore voted in a cause so conducive to the glory and prosperity of the State.

The great labor that has been expended in the examinations of the country between the Oconee river and this place, has resulted in the discovery of a route of a more favorable character than could have been expected in so uneven a section of country. The total distance from the city of Savannah to the Ocmulgee river by the route of the railroad, is 190 1-4 miles, and the distance of grading remaining to be done is less than 50 miles. The road is now in regular daily operation for a distance of 122 miles, and about 200 wagons engaged in hauling freight from the depot to different parts of the State.

The business has so far during the present season, far exceeded that of the last, and there appears now to be no room for a doubt of the entire success of the enterprise, and the profitableness of the investment of capital. We also learn that the grading remaining to be done, will probably be offered for contract within a few weeks.

As it probably will be interesting to many of our readers to learn the route by which the road will enter the city, we would mention that the one first contemplated by the valley of Walnut creek, has been abandoned, and another several miles below substituted. It now descends to the Ocmulgee valley by that of Boggy branch, crosses Walnut creek in the margin of river swamp—passes to the left of the large mound, and branches just below Evan's brick yard, one line passing up, and parallel with the river, on the east side, above the bridge, the other crossing the river, and ending at the foot of Cherry street.—*Georgia Messenger.*

Baltimore and Ohio Railroad.—The directors of this company are pushing the work with great energy, and reaping a substantial reward. During the past year the gross receipts on the main trunk, of the road were $432,883, from which is to be deducted for all disbursements, $290,055, and there remains $142,828 as the nett receipts for the year.

The receipts of the Washington branch were $202,755, disbursements $123,532, leaving a balance of $79,244 as the nett income.

The extension of the road to Cumberland is rapidly progressing, 1600 men and 500 horses are now at work upon it; and it is asserted, that should their resources allow the board to procure the iron and other materials in season, to make sixty or seventy miles of railway in the course of the year 1841, and to prosecute the remaining thirty or forty miles in the spring of 1842, it will be practicable to finish the entire work, and put the road in operation to Cumberland in the summer and autumn of that year.

Western Railroad.—Below is a statement of the receipts and expenses of that portion of the Western railroad which is now open, extending from Worcester to Springfield, fifty-five miles. The results are highly satisfactory. The way travel and freight, are not only paying the expenses of the road, but already yield a handsome revenue; and when the road is opened

to Albany, and becomes, as it soon must, a thoroughfare between Boston and the great west, it is obvious that its revenue must be much increased.

Receipts for Passengers and Merehandize on the Western Railroad, Massachusetts, for six months, euding 30th September, 1840. Three trains per day, each way.

MONTH.	Passengers.	Freight.	Total.	Expenses.	Nett income.
April,	4,067 60	4,405 17	8,472 86	4,709 65	3,763 21
May,	5,219 60	3,198 35	8,416 95	4,609 66	3,807 29
June,	8,007 28	2,388 73	10,496 01	4,426 87	5,969 14
July,	6,987 06	2,434 04	9,422 10	3,890 95	5,531 15
August,	9,316 77	2,979 00	12,295 77	4,199 91	8,095 86
Septem.,	12,750 74	4,038 00	16,788 74	4,400 00	12,388 74
	$46.349 14	$19,442 29	$65,792 43	$26,237 04	$39 555 39

Add for transportation of the mail, $2000, and we have a nett revenue of $41,555 39.

We are happy to learn that fifteen miles more of this road, viz: between Dalton and the State line, will be put in operation in the course of the next month, and that the 28 miles between Springfield and Chester will be opened early in March next. The whole line of the road from Boston to Hudson, on the Hudson river, except two miles at the summit, will no doubt be opened in July next; and, by the first of January, 1842, we expect to pass on the Western railroad from Boston to Albany.—*Boston Courier.*

This road will cost not far from $7,000,000. It is calculated to support an engine of 14 tons weight, and to carry 1000 barrels of flour in a single train of cars, 10 miles an hour. It is estimated that when finished, flour can be transported from Albany to Boston, 201 miles, for 30 cents per barrel. Two thousand men are now at work on this road, in some sections, both night and day.—*Gloucester Tel.*

Norwich and Worcester Railroad.—The receipts on this road for freight and passengers, for the last six months, being the first six months of the operation of the road, have been $77,390 74; for mails, etc., $1,933 08; making an aggregate of $97,373 82.

The friends of this enterprise anticipate that the amount of receipts on this road during the next year, will be double what they have been during the present year. The road will then have been finished, the buiness of the country will be more effective, the manufacturers on the borders of the railroad will more universally avail themselves of this new avenue.

Steamboats of a superior character will be placed on this route, one of which will be a new boat, built for the line by the present steamboat company, of 640 tons burthen, and of great speed; and in addition to this there will be the regular annual increase of business, which is *created* by a railroad found by the experience of England and this country, to 20 per cent. per annum or a doubling in five years.

We understand that the above receipts for the last six months, enable the company, after paying all expenses and interest, to divide at the rate of between five and six per cent. per annum, and as the expense will be no greater for a moderate increase of the business of the road, and as the company have permanent loans, principally at an interest of five per cent., the addition of $1000 per week, or 25 per cent. to the gross earnings, will very nearly double the amount of dividends to the stockholders.—*Ægis.*

Canal Tolls.—The amount received for tolls on the New York State canals during the second week in October, is $79,776 56.

Genessee Valley canal.—The amount received during the month of October for tolls on the navigable portion of this canal, (36 miles,) is $2,963 39. There has been shipped on the canal during the month, 141,972 bushels of wheat, and 22,444 barrels of flour. The lockages for the first lock out of Rochester, for the north, number 384; and those at the Scottsville lock, 327. The aggregate of tolls from the opening of the canal in September to the first of November, is $4,334 69.

Wabash and Erie canal.—Boats are now dispatched daily on this work, between Maumee city and Providence.

American Engines.—We are glad to learn that American mechanical genius is appreciated in England, and that for the immense amount of railroad iron which the United States has received from Great Britain, the latter country is receiving from the former, in part payment, many excellent locomotive steam engines for her own railroads. The subjoined is part of a letter from a friend in Liverpool, written on the 30th of June.

In answer to your inquiries as to the locomotive engines shipped to this country by your enterprising citizen, William Norris, under contract with some of our railroad companies, I am happy to say, that they have succeeded to admiration. Some delay arose in testing some of them, arising from the circumstance of his head engineer, or manager, on this side of the water, having on two occasions, been detained on the continent by Mr. Norris's business there, longer than he calculated on; and nothing could be done in the trials of the engines in his absence. Every thing has resulted very satisfactorily, and all his engines have been promptly paid for, except the last, which was shipped in April, and is of the largest class, which is now on trial—and his agent tells me that the trial is nearly completed to perfect satisfaction, and which the company will pay for in less than ten days. I am further informed that all of Mr. Norris's engines give very great satisfaction, and that orders have recently been sent him for four additional ones.

Anthracite Iron.—Anthracite iron is appropriately termed in the Philadelphia commercial list the second staple of Pennsylvania, the first being coal. That paper remarks, that although not one year has elapsed since it was brought into use, it has already increased with a rapidity that may fairly be taken as the harbenger of what it is destined to become in a few years. Within the brief period of nine months there have been constructed and are now in blast, three furnaces making iron of the first quality, with no other fuel than anthracite coal. They have been in blast from three to five months, and turn out from 40 to 50 tons of pig iron weekly. During this time many experiments have been made, in nearly all of which it has been satisfactorily ascertained that they can be managed and kept in order as easily as the furnaces using charcoal or coke. Two more furnaces are erected, which are to be put in blast this month. Sixteen more furnaces are already erected, or are now in progress, all of which use anthracite coal. Four large rolling mills with puddling furnaces are erected. one of which is in successful operation; and the other will soon commence manufacturing with coal as fuel. Two additional mills are to be put up this winter and next spring.

The above twenty-one furnaces and six rolling mills with their puddling furnaces will all use anthracite coal as a fuel. Thirteen of the furnaces and five of the mills are located on the line of the Lehigh and Morris canal, and will create a tonnage, including ore, coal, limestone and pig iron, of 227,500 tons, of which amount there will be 90,000 tons of coal obtained from the Lehigh mines.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 11, Vol. V. New Series. | DECEMBER 1, 1840. | Whole No. 371. Vol. XI.

RECENT ENGLISH PATENTS FOR PAVING WITH WOOD.

A late number of the London Journal contains no less than seven patents for paving, and all of them referring to the use of wood. Nothing can better exemplify the misplaced ingenuity of men having an excess of contrivance in their mental organization, than the consideration of some of these patents. Without pretending to enter into all the minutiæ of these papers, which would require numerous cuts, we propose to give a general idea of them and in some places introducing along with the description the remarks of the editor of the London Journal.

The invention of H. S. M. Vandeleur consists "in forming or shaping two surfaces of each block to angular figures; The angles of different blocks being produced by radial lines from a point distant from under the side of the surface of the road or other paved way; such lines not running from the bottom to the top of the blocks, but only running partly up the block; the part of the side surface being produced by radiating lines from a point above, and the lower side surfaces from a point situated below the surface of the road or way.

It is manifest that the blocks cut in the manner directed will vary in form and while the central one resembles a prism the outside ones will have such an acute salient and reentrant angle as can scarcely be executed by common instruments, while the waste of material wlll amount to nearly one half. The plan then, however, ingenious can never be applied in ordinary cases. Another and far better method of fastening proposed by the same patentee consists in the employment of rectangular blocks with notches or grooves cut out of their corners, midway between the upper and lower surface of the piece, and intended to receive a small tye block. The consequence is that four blocks are thus secured by one tye and each block having four tyes it becomes impossible to depress any one block below the general surface. The last contrivance appears to be one of the simplest we

have seen, involving little expense in sawing and answering a good purpose.

It may here be remarked that a general feature in all these patents is the support furnished by keying the blocks, and the necessity for this is owing to the oozy substratum of the streets in many parts of London.

The invention of Daniel Ramee, as far as relates to paving alone, has reference not to the material or its shape, but to the binding together the blocks whether of wood or stone. This is done by means of frames made of bars of iron strongly bolted together by wedges which are forced in tight when the frame is filled with stones. A modification of this consists in the use of masses formed by fastening by straps and wedges four or more small blocks. Some times when the iron framing is used, the blocks of stone contained therein are tightened by wedge-formed border stones, which being forced down among the other blocks, press them tightly and closely together. It is not necessary to make comments upon this invention as it is too expensive to be used, except in certain cases to a very small extent.

The contrivance of John Browne is for the same purpose as the last. The frame work consists of iron ribs, having the required curve of the road and on these the blocks are placed. The frames are fastened together so as to prevent inequality in the surface of the road.

The next patent on the list is that of Robert Carey. The claim is for "constructing blocks of wood, which, when placed together and accurately fitted, shall alternately present a concave and convex form, and thereby tending to support each other." In short, but two kinds of blocks are needed, one narrow in the middle approaching the form of an hour glass; the other wider in the middle with its convexity fitting into the cavity of the other. "It will be seen that each separate block both supports and is supported by all those with which it is in contact, so that upon a weight being placed upon any particular block, the four surrounding blocks each assists in supporting the same, as, indeed, do all the other blocks for a considerable distance around, because it is impossible for any block to sink with carrying down four others with it; and these others are in their turn supported by such other blocks as they may be in contact with. It will therefore be evident that the strength necessary to support any weight, will be obtained from all the surrounding blocks." The editor of the London Journal remarks,—"This appears to us to be the best description of wood paving yet offered to the public and would be the most likely to meet with encouragement, if any economical method could be devised for cutting or forming the blocks with correctness.

The ingenuity of David Stead and Stephen Young (each having obtained a patent) appears to have exhausted itself in forming all possible combinations of shapes, in short in devising the most ingenious Chinese puzzles. The result is a claim on the part of both patentees to nearly every possible shape of block, from the most simple to the most complicated, and therefore the most useless. On feature common to both plans, or rather

to one of the many plans of each, is the use of a double course. The last notice we have to make is of the patent of Richard Hodgson. It consists in combining two wedges placed side by side with the point of each beside the middle of the base of the other, or else in the use of two oblique parallelopipedons fastened together in the form of X and the consequence of the use of either of these solids will be a perfect contact of all parts and a perfect keying together of the pieces not unlike the lattice bridge. There would be no objection to this plan were it not that the waste of material is great, except perhaps in the case of wedges where a careful management would avoid any great loss.

We have thus taken the trouble to throw into a condensed form the substance of the patents, with the desire that any hint of a useful character might be extracted, without the trouble of unraveling the complicated descriptions, as we have done at no small cost of time and trouble. But after all, these contrivances are rather curious than useful, and we much doubt whether either of these patentees will ever be reinbursed for the expense of the patent, &c. The superior strength of any one of them, will be more than counterbalanced by the increase of cost, and it must also be recollected that in the least complication of parts, the unavoidable shrinking that takes place will prevent the perfect contact necessary to insure a good and lasting pavement.

As far as strength and simplicity are concerned nothing can be better than prisms of four or six sides pinned together so as to distribute the strain where any one piece over a large space.

Self Acting Safety Brnak.—We find in a recent number of the London Mechanic's Magazine, a notice and drawing of a self acting brake invented by Mr. Ware Jones. We merely allude to it as it shows no originality, and is similar to one described in Vol. 4 p. 231 of the Mechanic's Magazine, the invention of J. K. Smith.

For the American Railroad Journal and Mechanics' Magazine.

REMARKS ON THE "LAWS OF TRADE." By C. Ellet, Jr., *Civil Engineer.*

No. 3.

In the preceeding numbers, the toll proper to be charged on the public works of the country, for the conveyance of objects of heavy burden, is determined in the supposition that there are limits and rules, prescribed either by law or by political considerations, which prevent a departure from some fixed amount per ton per mile; and, under this hypothesis, results have been obtained of remarkable simplicity, and very general application. But we are not to overlook the fact that it is only in cases where such imperative considerations govern, that a tariff based on the principles assumed could be adopted—since its adoption will be universally attended with a loss of revenue, and always productive of injustice to the public. Still, this mode of assessing the charges on the trade is in very general usage in the country; and it is therefore an important and interesting question to

determine *the amount* of the loss which it involves, by a comparison of the revenue obtained under an uniform charge with that which would be produced by a proper attention to the value of the commodity, the space it is carried, and the freight charged on the line.

It is elsewhere proved,* that when the work is yielding the highest results, the toll per ton per mile on any commodity transported a distance x will be

$$C=\frac{\Pi-x\delta}{2x};$$

and the tonnage due to this toll, which will be furnished by the two opposite branches joining the line at the distance x from the mart, will be represented by

$$T=t\frac{\Pi-x\delta}{\beta};$$

and the differential of the revenue which will be obtained from this tonnage under the charge C for toll, will be

$$t\frac{(\Pi-x\delta)^2}{2\beta}\delta x.$$

By investigating this equation we shall obtain for the value of the revenue between the limits $x=o$ and $x=h$,

$$R=t\frac{3\Pi^2h-3\Pi h^2\delta+h^3\delta^2}{6\beta} \qquad \text{(E)}$$

The extreme value of h is obviously $\frac{\Pi}{\delta}$; and consequently, by substituting this quantity in place of h in the equation, we shall have for the aggregate revenue from any commodity

$$R=t\frac{\Pi^3}{6\beta\delta}. \qquad \text{(F)}$$

The tonnage corresponding with the charges which produce this revenue will be represented by the differential equation,

$$dT=t\frac{\Pi-x\delta}{\beta}dx;$$

observing, as before, that the tonnage is obtained from the country on both sides of the improvement.

By investigating this equation between the limits $x=o$ and $x=h$, we find for the tonnage in that distance

$$T=t\frac{2\Pi h-\delta h^2}{2\beta}; \qquad \text{(G)}$$

which, when $h=\frac{\Pi}{\delta}$ (its greatest value) becomes

$$T=t\frac{\Pi^2}{2\beta\delta}. \qquad \text{(H)}$$

If we compare the expression of the revenue given in equation (F) with that which we obtained under the hypothesis of an uniform toll equal to

* "Essay on the Laws of Trade," page 65.

the charge for freight, we will perceive that they are of the same form—both being as the cube of the tare for carriage which the commodity will bear, and inversely as the cost of freight on the lateral branches and on the improvement—but that the revenue in the latter case is twice as great as in the former. Or, *where the charge for toll is adapted to the ability of the article, the revenue will be twice as great as the greatest revenue which can be obtained when the toll is some given amount per ton per mile.* At the same time, if we compare the tonnage under the two hypotheses, as given in equations (C) and (G.) we will perceive that it is the same in both cases—these expressions being identical. From which it appears that we would be able so to adjust the charges on that class of commodities now under consideration, that the revenue would be twice as great as in the hypothesis of an uniform charge, and that yet there would be no diminution of tonnage. But it would not be practicable to carry out this system of assessment quite to the extent here assumed, and it would probably be found advisable to make some modification of the charges on articles carried but a short distance, by which the revenue would be somewhat reduced, and the tonnage proportionally augmented. The effect of such modifications as are here adverted to, depend on various circumstances, which, though susceptible of being exhibited in a general solution, would be more conveniently exposed by particular application.

To obtain such a solution of the problem, we may regard the tariff as common to the two systems for a certain distance h, and then integrate both expressions of the revenue, between the limits $x=h$ and $x=\frac{\Pi}{\delta}$ in the one case, and $x=h$ and $x=\frac{\Pi}{2\delta}$ in the other, and compare the results in the particular applications which we desire to make.

Again, if we compare equations (F) and (H), we will find for the revenue under the tariff recommended in the "Laws of Trade,"

$$R=\frac{T\,\Pi}{3}; \qquad (I)$$

which teaches that when the tolls are judiciously levied *the revenue obtained from any article will be equal to the whole number of tons of that article which is shipped on the line, multiplied by one-third the charge for carriage which one ton will bear*—without respect to the distance through which any part of the trade is carried.

This method of determining the most advantageous tariff, may be employed in the question of railroad fares with very happy effect; but the consideration of that division of the subject will be deferred for a subsequent article.

To the Editors of the American Railroad Journal and Mechanics' Magazine.

Owing to field engagements during the past season, I was prevented from receiving your Journal regularly and paying attention to its perusal. But

I feel now called on to make some remarks on an anonymous article, which appeared in the second number of the month of July, on page 36, 37, 38, headed "*Theory of the Crank.*" The position I have assumed respecting the *Crank*, devolves on me the duty, either to acknowledge myself in error, if becoming convinced in the course of debates, of the incorrectness of the proposition, advanced by me; or to meet all objections, which appear to me unfounded.

The article referred to has the appearance of a plain and mathematical construction, equally well calculated to *convince* as to *deceive.* It would settle the matter at once and decide against my theory, if it was not for a slight mistake, which has crept into its construction. This mistake is nothing less than the liberty which the author has taken, *of proving the thing which is to be proved, by the thing itself.*

The reader is requested to peruse again the article in question, and to refer to its diagrams, fig. 1, and fig. 2, and to keep in mind that the action of the crank-pin is supposed to take place in the quadrant A B, fig. 1.

What I have asserted is, that there is a loss of power connected with the use of the crank, arising from the change of a straight motion into a rotary motion.

Our author now says, on page 37:

"Make the line *a b*, fig. 2, equal in length to the arc A B in fig. 1, and suppose ordinates to be erected from the several points between *a* and *b*, equal in length to those drawn from corresponding points in the quadrant. That is, *ah* and *ai* being equal respectively to A H and A I. From *a*, through the points *k*, *l*, etc., draw the curve line *a*, *k*, *l*, *d*, etc."

The crank-pin moves in reality not in a straight line, but in a circular line. Our author now has the arc A B metamorphosed into a straight line *a b*, and the ordinates, representing the leverage, *vertically to it*. Now since a straight motion has been substituted for a circular motion of the crank-pin, it follows as a matter of course, that *no* loss of power will be proved and that the principle of virtual velocity will be found to hold out. The vital part of the question has been at once circumscribed and silenced by the author, by presuming that a circular motion may be represented as taking place in a straight line; while I have been contending for, that a circular motion cannot be assumed as straight, even for the smallest particle of time or extent.

Again: I consider it a mathematical plunder, to resolve the leverage and to dispose of it, *without relation* to the prime mover or its course. But this has evidently been done in diagram 2, where the ordinates are represented verticals to the line *a b* which line is to represent the space through which the crank is moving.

The author says again on the same page, 37:

"As the crank in passing with an uniform motion from A to B or its equal *a b*, acts with the different levers represented by the ordinates, drawn to the several points, it follows that the area of the figure *a l d b* represents

correctly the sum of all the different levers, upon each of which the power operates an equal length of time, etc."

I now ask, who can assent to confound the way of the *prime mover* with the way of the *crank-pin?* Is not the leverage always to be calculated vertically to the direction of the prime mover?

The sum of momenta produced during a quarter revolution upon the centre D, fig. 1, is equal to the product of A D× *by the total leverage of the quadrant.* The leverage of the quadrant is represented by the sum of ordinates H K, I L, B D which are drawn vertically to the direction of the prime mover WITHIN THE QUADRANT. We cannot construct the leverarge as taking place under other forms and circumstances, nor *outside of the quadrant* nor in a larger space than the quadrant.

From all those reasons I must object to the Theory as offered by the author.

The communication of Mr. B. Aycrigg, in your Journal of September 1st, contains a critic of my last reply to his first writing on the crank.

In answer I beg leave to state, that his argument, as far as my position is concerned, appears to me unsatisfactory.

I do not understand at all Mr. Aycrigg's objection to what I consider to be a self evident truth, viz.

"*That the respective velocities of the prime mover and of the crank-pin are as the spaces through which they have actually moved.*"

By what are velocities of motions expressed or represented or measured? No doubt by the extent of spaces, through which the motion has taken place for a certain space of time. It matters nothing, if the time of motion was a fraction or a whole; it matters nothing if the velocity of the crank-pin is considered for an instant or for the whole time required for a whole revolution. What is true for a single instant, is also right for a multiplicity of instants, provided the multiplicator is the same on each side of the equation.

I say, it is impossible to deny that the velocity of the crank-pin is in exact proportion to the space through which the pin has moved, either for an instant or any other extent of time. The space now, through which the crank-pin is moving, is represented by the arc, and the motion of the prime mover is measured by the verse sine. Therefore the following rejected proportion: $V : v : :$ sine verse c : arc c appears at least to my mind, perfectly correct.

I have said that the verse sine can bear no definite relation to an arc, and Mr. Aycrigg asks: "*Does he then mean that the respective velocities of the prime mover and of the crank-pin have no definite relation to each other?*" I mean exactly what I plainly expressed: *that the verse sine can bear no definite relation to an arc*, and nothing else. The verse sine can bear no more definite relation to an arc, than the radius does to the circumference of a circle. Both relations are indefinite and cannot definitely be expressed. It follows of itself, that the relation of the veloci-

ty of the prime mover to that of the crank pin cannot be a definite one, they being to each other as the radius to the quadrant. And the relation of the two last quantities is expressed by a decimal fraction without limits.

The simple *Theory of the Crank*, which was first offered by me, was itself never scrutinized, except in one case, which was explained by me.

Now it is plain, that one demonstration is all sufficient, and that, if a proportion has been proved *right* once, it cannot be proved *wrong* another time. But this has been attempted with respect to my theory. Instead of explaining, in what the fallacy of the reasoning of the new proposition consisted, other demonstrations have been offered for the purpose of proving *no loss of power.*

I should feel obliged to any gentlemen who will trouble himself to examine my demonstration carefully, and will point out in inoffensive language, where I have erred. So far I have no reason to abandon my assumed position. No fallacy has been discovered in it and the opposition demonstrations are as yet unsatisfactory, at least to my mind.

JOHN A. ROEBLING, C. E.

AN ESSAY ON THE BOILERS OF STEAM ENGINES. By A. Armstrong, Civil Engineer.

(Continued from p. 285.)

ON THE FORCE OF EXPLOSIONS.

From the premises we have laid down, it may fairly be concluded, that the pressure of steam, suddenly generated at the moment of explosion, will bear some near proportion to the area of the hole or aperture, and as the actual pressure exerted the instant after the aperture is formed, must be equal to the previous pressure drawn into, or multiplied by, that area, we may assume the square of the area, or fourth power of the diameter of the aperture, as representing a good approximation to the proportional force exerted—the reaction of this force propelling the boiler in a direction opposite the aperture.

Hence we have a reason why the bursting of a comparatively small hole in a boiler bottom produces such a very feeble effect, as compared to one of six or eight times its diameter. For if the force of explosion in any given case be called 1, then the force in any other case, producing an aperture of double the diameter of the former (other circumstances being the same) will be represented by $2^4=16$; if of

3 times the diameter, it will be	$3^4 = 81$
4 times	$4^4 = 256$
6 times	$6^4 = 1296$
8 times	$8^4 = 4096$

Some persons who have paid a good deal of attention to the circumstances connected with explosions, have doubted the possibility of steam being generated in sufficient quantity so suddenly as my explanation would seem to require; this, of course, is a matter which can only be proved by direct experiment; and such an experiment is yet a desideratum in this country. At present we have only one of the American experiments which throws any light upon this part of the subject; the repeating of this experiment on a large scale is highly desirable, although it would be attended with some danger and not a little expense. In the one alluded to, water was purposely injected into the boiler when the bottom was *red hot*, by

which means the steam was raised from one up to *twelve* atmospheres (180 lbs. per square inch) *in one minute*, when the boiler exploded with violence. The American report states that in the violence of the effect, the experiment was not carried so far as it might have been, from not throwing in a sufficient quantity of water; consequently, the metal was not *cooled down to the* "*point of maximum vaporisation*" when the explosion took place, otherwise the pressure, as indicated by the thermometer the moment before the explosion, might have reached about 40 atmospheres in the same time.

The above mentioned experiment supplies an illustration of the general inutility of safety valves in case of sudden explosion. The safety valve is, in fact, a perfectly useless appendage to a low pressure boiler provided with the ordinary feed pipe in common use in factories; more especially when the buoy rod is made to pass through an open pipe of the same height as the feed cistern, instead of working through a stuffing box. This well known feeding apparatus is an infallible preventive against the steam getting (*gradually*) too high, as well as against the water getting too low; the latter being by far the most dangerous predicament of the two, and a frequent cause of explosion.

When a boiler bottom becomes very highly heated through the water getting too low, and a quantity of water is suddenly let in, the consequences are similar to those we have already described; for the internal coating of scale being suddenly contracted by the admission of the cold water, it is detached in the same manner as by the expansion of the iron, and the same effects are produced, although perhaps more speedily, as the water admitted will reduce the temperature of the exposed part of the boiler bottom more rapidly to the maximum evaporating point.

It may be asked, if our theory of steam boiler explosions be correct, how it is that we have not many more of them, as the causes to which they are ascribed may seem to be of almost every-day occurrence? The answer is, that the *bursting of boilers* is also a matter of every-day occurrence, to an amount which the public generally are altogether ignorant of. To be sure these burstings are not generally called *explosions*, although in reality they are so, being different only in degree. It would not be difficult to prove that two or three of these minor explosions occur in Manchester every week; but when no fatal consequences ensue, and no particular damage is done to any adjoining property, of course the circumstance never gets into the newspapers, and no public notice is taken of it.

Usually, the affair has quite another name when it occurs with a wagon boiler; it is then said that the "boiler bottom has come down;" in other words, the concave bottom is forced down into a convex form, and sometimes the sides are in like manner forced outwards, about the middle of the length of the boiler. The consequence in the least violent of these cases is, that the boiler is lifted up a few inches from its seating by the bottom striking upon the top of the fire bridge. We also usually find every seam of rivets violently strained, so that the water runs through the boiler bottom like a riddle, although there is seldom a hole of more than a few inches in area.

The above remarks of course have reference principally to those cases where the metal of the boiler becomes unduly heated, either in consequence of the water getting too low, or from the interposition of incrusted deposits, as described in the preceding articles (239, etc.) There are, however, other concurring causes that frequently modify the result; such, for instance, as when, instead of the bottom or sides of the boiler, it is the top of the inside flue that becomes unduly heated. And this is an extremely

likely cause of explosion, when the furnace is contained within the flue, as in the Cornish boiler and some others.

There is a very erroneous, although prevailing opinion, that the Cornish or Trevithick boiler, with the fire inside the tube, is safer than any other kind, which opinion cannot be too soon dispelled. For it is an admitted fact by all who have considered the subject, and however they may differ as to the precise theory of its action, that the water getting too low is a frequent cause of explosion; and if so, it must be evident that this cause must operate much more frequently to produce such an effect, when, as in the Cornish boiler, the depth of the water over the hottest part of the heating surface is only a few inches, than when the depth is as many feet as in the wagon boiler.

The force of the steam and water escaping during an explosion of a Cornish boiler is, however, immensely increased, by reason of its being generally all expended in one direction, that is, through the fire place in the mouth of the tube. The latter being thus converted into a sort of cannon or mortar, from which the grate bars, fire bricks, and other materials are projected with destructive effect, on every thing within their range.

It is also not improbable that the steam, as it rushes out, is reinforced by contact with the heated fuel in the furnace.

There are, besides the above, some other circumstances that have been observed in the bursting of a boiler of this kind, which show that the explosion bears considerable analogy to the discharge of an immense piece of ordnance. Such, for instance, is the sound or report produced by the explosion, and which is not experienced in so remarkable a manner with boilers that have not an internal flue.*

It frequently happens that explosions of the Cornish boiler occur without the latter being in the least disturbed or removed from its place; such were the two fatal explosions on board the *Victoria* Hull steam ship on the Thames, in March and September, 1838, the particulars of which are well known.

An explosion of a similar kind to those in the Victoria steamer, also took place not many months ago with a Cornish boiler at the Viaduct foundry, at Newton, in Lancashire; but the boiler being a high-pressure one, the force of the explosion was much greater than in the former case. Several tons in weight of cast iron and other articles were removed by it, and a breach was made by them, of ten yards wide, through a strong wooden inclosure that surrounded the foundry yard. Indeed, every thing in the dieection of the mouth of the tube, for 60 or 70 yards in a direct line and two or three yards wide, was swept away with terrifio violencc, including ten or eleven workmen, nine of whom were killed. The bricks which had composed the fire bridge within the tube were projected like shot from a gun to twice the above mentioned distance, and were the principal cause of the loss of life. The report was described as like a loud clap of thunder.

It is necessary to say that the incrustations of which we have spoken as common cause of explosions, had nothing whatever to do either with this case, or those of the Victoria steamer, the boilers being quite new; these instances are only adduced as illustrations of the peculiar destructive violence incidental to this particular kind of boiler, owing to the steam be-

* It has been observed, that when one or more flued boilers are working in connection with another which explodes, the water immediately boils out of the former into the latter, and a continuation of the effect is produced for several seconds, together with a prolonged rumbling sound, which has been described as like thunder.

ing reinforced as it were within the tube, and then being all expended in one direction. Respecting the causes concerned in those particular explosions we shall have more to say.

ON EXPLOSIONS CAUSED BY MALFORMATION OR WEAKNESS OF SHAPE.

We may take the last stated case of the Viaduct foundry boiler as an illustration of this class of causes, for although not very commonly productive of explosions properly so called, they deserve the particular consideration of the users and makers of *high-pressure* boilers.

The peculiar fault of this boiler and the proximate cause of its bursting was, that the tube or internal flue was oval in section, although the boiler itself was circular.

Now the main object in making an inside flue oval and placing it with the shortest diameter vertical, is no doubt the obtaining a greater depth of water over the flue without diminishing the heating surface; but by thus endeavoring to avoid the chance of an accident arising from a deficiency of water, we run into the contrary extreme, and risk an explosion by making the flue of a weak form.

A very slight departure from the true circular figure, not only causes a flue to be much weaker, but the pressure has a constant tendency to still farther alter the form of the curve, thereby becoming weaker with every strain, until the boiler bursts by what is called a collapse of the flue; that is, the two sides are usually crushed flat together, or nearly so, and the rupture consequently takes place in the flue itself, through which the steam and hot water are discharged in the manner we have already stated.

The Viaduct foundry boiler was 12 feet 6 inches long, by 4 feet 9 inches in diameter. The inside flue was 3 feet wide, by 2 feet 6 inches deep. The fire bridge was at about one-third the length of the flue, and the top and bottom of the latter were crushed together at about midway between the back end of the boiler and the bridge; the latter no doubt by acting as a momentary support to the top of the flue at the instant of the plates coming down, determined the place of the collapse.

The above boiler was quite new, the explosion having taken place the first morning it was set to work, and within one minute after starting the engine. The plates were of three-eighths of an inch thick, and, saving the *form* of the flue, the boiler was remarkably well made, as well as all the apparatus belonging to it. It had two *safety valves,* two gauge cocks, and a glass water gauge. The foreman of the works, who had the superintendence of erecting both the boiler and the engine, (the latter being also new and of eight horse power,) was present and managing them himself when the explosion took place, he being also one of the unfortunate sufferers.

The verdict of the coroner's jury in the above case was "accidental death *occasioned by the insufficiency of water in the boiler,*" which conclusion seemed to be arrived at, either from insufficient evidence, or inability to account for the accident in any other way; although there was direct evidence to the contrary, namely, that the gauge cocks indicated sufficient water a few minutes before the explosion, and that no steam was blown away in the interim. In concurrence with the opinions of the jury were those of several most respectable engineers, but with the addition, by some of them, of ascribing the explosion to the *sudden formation of hydrogen gas,* by the injection of cold water upon the supposed red hot flue when the engine started. This last opinion is far from being a singular one in many similar cases of explosion that have occurred with high pressure boilers, but is, as we think, a very erroneous one, not to say fatally so, in

many instances. For by thus assuming a theory which, to say the most for it, is, according to our ordinary knowledge of the laws of chemistry, extremely improbable, a check is, to a certain degree, placed upon any further investigation, while the real errors of construction are perhaps kept out of view or repeated in other cases.

Now, if instead of the flue the *boiler* itself had been *oval* and the *flue circular*, the same means of obtaining a greater depth of water over the flue would have been afforded, but with much greater safety from explosion or collapse. For although an elipse or oval is a weaker shape for a boiler than a circle, still from the pressure being *inside the curve*, any extra strain or pressure that the boiler may be exposed to, will only have a tendency to alter the curve into a stronger shape than it was before, or to approach more nearly to the circle. On the other hand, when the pressure is on the *outside of the curve*, the effect is exactly the reverse of the above, the strain having a constant tendency to put the curved surface into a weaker position; consequently it follows, that a boiler slightly elliptical or oval in section, is, for all practical purposes, as strong as if it were circular; while, in an internal flue or tube, where the pressure acts externally to the arch or curved surface, if the curve is not truly circular, the tendency to give way and be crushed inward by what is called a collapse, will increase in an increasing ratio with the strain.

Hence it ought to be a rule in the making of high pressure boilers, that the inside flues, besides being circular, should also have their plates quite as thick, if not thicker, than the external shell or case. The boilers themselves may be to a considerable extent elliptical, even so much as in the proportion of 6 to 8, without materially diminishing their ultimate strength. Contrary, however, to the above recommendation, we frequently see a different practice followed, that is, the dangerous one of making oval inside flues of thinner iron than the boiler. If the peculiar form of boiler should in any case absolutely require oval flues, which may possibly be allowable for low pressure, those parts ought to be carefully supported by stays.

ON EXPLOSIONS CAUSED BY IMPROPER POSITION OF THE HEATED SURFACE.

An attentive perusal of the section on the position of the heating surface (in Chap. III. Art. 120, etc.) together with the preceding sections of the present chapter, besides bearing in mind what has been hitherto generally known on this subject, will, it is to be hoped, enable us to eliminate all the causes that were ever concerned in producing explosions of steam engine boilers; and perhaps also put us in a condition to assist, if not in preventing, at least in placing some check to, the increase of those lamentable occurrences, and thereby tend to the removal of the only remaining barrier of any consequence to the further progress, and eventual complete triumpth of the empire of steam.

There are only two ways in which a boiler can be made to burst or explode by the power of steam. One is by a gradual increase of the pressure produced in the usual way, but at a time when all egress is prevented until the steam acquires sufficient strength to force its way out by a rupture of the material of which the boiler is made. The other way is by some *sudden* increase in the quantity or pressure of the steam, to such an extent, that the ordinary safety valves, or perhaps any other means of outlet that might be devised for the purpose, are unable to carry it off with the requisite rapidity for preventing any (although but momentary) strain greater than the boiler can bear. We have long been of opinion that it is in the

consideration of the last above two classes of causes principally, that we ought to look for the proper remedy.

It will be recollected by those who read the newspaper accounts of the second explosion on board the Victoria steamer last summer, that great stress was laid upon the peculiar nature and situation of the injured portion of the boiler, the principal place of fracture being the lower part of the inside flue or tube by what is called a collapse of the flue *upward.* The boiler was on the circular or Cornish principle, that is with the fire place inside the tube, which was slightly elliptical, but of a very large size, so as to allow of merely a shell of water between it and the external case. Moreover, this boiler contained an inner tube within the flue tube, containing water, and communicating by means of short pipes with the upper part of the boiler, similar to some that have been lately introduced in Cornwall, therefore it has been called the "improved Cornish boiler." The boiler in this case had return flues underneath its bottom, and set up somewhat similar to the ordinary manner in which a Butterly or Cornish boiler is set up for mining or factory purposes,—a highly objectionable method, in our opinion, when applied to a steam vessel; and we have no doubt of being able to show that this assisted in the production of the fatal catastrophe which took place in the Victoria.

A collapse of the flue upwards is not an uncommon occurrence in factory boilers that contain inside flues with rather flat bottoms; and it frequently occurs with what are called Butterly shaped boilers, or those which have the mouth of the inside flue a very flat oval, particularly behind the bridge where the fire first passes into the tube.

On this particular portion of the bottom of the flue of a Butterly boiler, and for a considerable distance beyond the bridge, we have known small coal and coal dust to accumulate into a heap of some magnitude. Now with a pretty strong draught, and the flame reverberating downwards, as it necessarily does in both the Cornish and Butterly boilers, this heap of coal dust occasionally takes fire and burns with more or less intensity according to circumstances,—never perhaps with sufficient intensity to make the iron any thing like approaching to a red heat in the first instance, but rather gradually to deteriorate and weaken the iron in the manner we have before pointed out, in the case of the side plates of the furnaces of marine boilers; excepting that in this case the injury is more rapidly effected from the circumstance of the bubbles of steam which rise from the lower heating surface coming continually in contact with the bottom and sides of the inside flue; thus, in some measure, preventing the water from carrying off the undue heat accumulated in the iron plate above it.

We have occasionally met with instances where the mischief done in the above way was first evinced by the bottom plates of the flue being so far weakened or softened as to give way to the pressure of the steam sufficiently to form a dish-like protuberance within the flue, and consequently a corresponding concavity on the under side or that next the water, into which the steam would of course accumulate or become locked in the manner described in Article 152, etc. Now, after the injury has proceeded thus far, it is very evident that a second accumulation and ignition of coal-dust, may cause the injured part to become rapidly red hot, or sufficiently so as to cause the flue to burst upwards with the ordinary pressure of the steam, and this effect is in fact what frequently takes place. We have had many opportunities of tracing the symptoms indicating the above effects, from their source, as above stated, to their full development in an explosion; and in one particular boiler in Manchester, this occurrence took place twice exactly in the manner above described.

That similar causes would produce similar effects in the Victoria boilers we have no occasion to contend, the priniples of their construction being the same as we have brieffy described above, the details of which any one may see by referring to the engravings of those boilers, published in the Civil Engineer's Journal, and also in the Mechanic's Magazine for last year.

The evil in all such cases arises from the principle (whether incidental or designed) of *heating water downwards*, which is essentially bad, and respecting which we have largely expatiated in various parts of this work. But our present business being principally with land or factory boilers, we have only to state that the evil is usually prevented by keeping the flues well cleaned out; but it would be better still, perhaps, to cover the bottom of the flues with fire bricks, or a coating of Roman cement, or any substance that is a bad conductor of heat.

In the particular case mentioned in the last article the flue was about five feet by three, and assumed a kidney shape—the transverse section having the indentation at bottom. The plates were about 3-8ths thick, and the pressure 9 or 10 lbs. per square inch.

(To be continued.)

FOURTH ANNUAL REPORT OF THE L. C. AND C. RAILROAD COMPANY.

(Continued from page 310.

From the report it appears that a portion of the advances made by this company have been refunded from the income of the Hamburg road; but as these fall short of the interest on the entire debt contracted, the result is not varied, and the cost of that road to the Louisville, Cincinnati and Charleston railroad company, remains fixed at upwards of three millions of dollars.

The locomotive power is reported as efficient and equal to all the probable transportation for the coming year on the road; and the work shops are represented as under efficient management, and in a condition not only to keep the requisite number of engines in order, and in active service, but to reconstruct those which have been disabled, and to furnish the additional number of new ones which may be demanded by the increased transportation on the road. There was a deficiency, however, of freight cars; and the additional number required are under construction. The work shops, sheds, and other structures at the depots, and particularly at Hamburg, and at that near Charleston, are all temporarily arranged without much order or with a view to permanency, and being of wood are much exposed to fire. An accident of this kind might not only result in great pecuniary loss, but in the entire suspension of the business of the road, as inconvenient and as embarrassing to the community as it would prove to the company. All these must require, in the progress of time, at a more convenient period than the present, entire new construction, and of materials which will render them more durable, and exempt from being fired. The depot on the Neck near Charleston, it is alike the interest of the company and of the community to advance into, or on the borders of that city; for it seems absurd, that a road intended to make more perfect the commercial connection between the interior and the shipping point short of its accomplishment. At the other extremity at Hamburg, there are considerations equally as imposing, and to which the community of Georgia, and all interested in the railroads intersecting that State, however opposed at present, must soon yield, for the advancing the South Carolina road into Augusta. At present the merchandize and produce of the country are subject at the two extremities of this road to a bridge, wagon and dray tax—in some cases equal to

40, and in most from 20 to 25 per cent on the entire freight from Charleston to Hamburg. All these impediments to a free and cheap intercourse between the harbor of Charleston and the interior, will involve further improvements; and therefore it has been recommended that from the capital to be paid in under the charter to the Louisville, Cincinnati and Charleston railroad company, there be reserved at least three millions as necessary to meet the obligations for the purchase, and the more permanent construction of the road from Charleston to Hamburg and Augusta, so that it may fulfil all the great objects for which it was originally projected. At that sum it will be found a purchase, and investment remunerating in time, it is believed to all, who retain their interest as share owners. To the Louisville, Cincinnati and Charleston railroad company, embarking as they have in an enterprise of great magnitude, of incalculable importance to the south and west, and involving a large amount of expenditure it was invaluable; and in the consummation of this purchase, we may now, with the greater confidence look to the ultimate consummation of the great objects for which that company was chartered. They received a road admirably located, the longest which has been constructed in the United States, organized in its government, and in full and successful operation in all the departments of police and transportation, for its management, with work-shops and motive power, and a most efficient class of mechanics, mechenist, and enginemen, most, if not all of whom had been educated in its own native school at the Depository, and where they imbibed, and still retain, an attachment or esprit, for the road. The expense, and the time, which would have been necessary to have organized, and to have given impulse to these arrangements, on a new and independent road, would have been incalculable. Already on the short section of road to Columbia, which has been completed, have the benefits of the connection with, and ownership of the Hamburg road and work-shops, been most advantageously experienced. Without the necessity of an additional outlay for new engines, passenger, and freight cars, &c., and with all the hazard of subjecting our first transportation operations to the management of discarded conductors, enginemen of other roads, or to those who only had the passport of a recommendation, and free from the embarrassment of having to negotiate with an independent road, by which the freight and passengers from Orangeburg, and beyond, should be expedited to Charleston on their track; it was only necessary to give orders to bring in harmony the transportation and travel in both directions, meeting at Branchville, and to furnish an engine and competent attendents, and the work was accomplished, and at a moderate expense, compared to what would otherwise have been incurred.

FINANCES, INDEBTNESS, ETC. ETC.

The Report of the Secretary and Treasurer, exhibits a statement of the finances and indebtedness of the Company up to the first of September, 1840. The expenditures have been separated and made chargeable under the different heads to which appropriated. The indebtedness of the Company, though greatly reduced, and brought more within our ability to meet it, is still large, and the expenses enhanced from a heavy and unavoidable interest account, which has, and must continue to consume a large portion of the resources of the company, if these debts cannot be provided for, or extinguished by the payment of instalments on the part of the stockholders. The amount of arrearages lying over, and probably equal to if not exceeding our bank engagements, and the mistaken policy hitherto of postponing the regular calls every sixty days, as the charter prescribes, for the sums necessary to build the road, and of granting indulgence, at the same

time that we were pressing forward with the work, had superinduced a system of loans to meet pressing claims, which has not only operated to the prejudice of the treasury, but very sensibly increased the cost of the enterprise. To this fact must be ascribed much of the excess of indebtedness which will remain over and above the capital estimated as ample, in the previous part of this report, for the construction of the two roads owned by the company, and which would have been adequate, but for the diversion, under a mistaken policy of credit, a proportion of the sum from its original legitimate objects; from the payment of debts, to the payment only of interest on debts, still remaining unliquidated. This interest, therefore, has oparated as a sponge, which has silently, but surely absorbed the slow receipts of our capital, and must remain as a large item, unexpectedly, but now unavoidably charged to either profit or loss, and to be added as an item on the amount of capital invested on the road.

In the division of surveys, the Engineer has, under instructions, divided the amount charged against the road, as far as Columbia, the sum fairly appropriated on that section, dividing among the other States the sums expended within their respective limits for said service, and leaving an amount chargeable against the company for the surveying operations above Columbia. Though these divisions were made with the view to the separating of the funds of the different States interested in the enterprise, as required by a resolution of the stockholders, and to ascertain as far as practicable, the amount for surveying chargeable on each section of the road, it cannot altar or diminish the liabilities of the company in the aggregate. The amount, therefore, for surveys beyond Columbia, though as a separate item, chargeable hereafter to the road above that place, is still so much of the company's funds prematurely disposed of, and which must remain as slumbering capital, unavailable until the enterprise advances beyond that place.

There has been expended for surveys, instruments, etc. in the Engineer

department, up to the 1st September, 1840,		$221,102 18
Of this amount there is chargeable against the section of road between Branchville and Columbia,	$85,000	
Above Columbia, in South Carolina,	43,102 18	
In North Carolina,	24,500	
In Tennessee,	23,500	
In Kentucky,	45,000	
		$221,102 18

From the Treasurer's Reports the liabilities of the company, up to the same period, are

To the Banks of Charleston,	$201,892 00
To Bankers in London, for advances,	14,300 60
To City of Charleston for advances on stock,	39,139 53
To State of South Carolina for advances on stock,	474,077 37
To State of South Carolina for advance to Hamburg road,	138,223 59
To notes drawing interest, and payable at 12 months date,	247,897 25
To Scrip (*Receivables*) of the denominations of $5, and under,	44,425 00
	$1,159,955 34
Add amount necessary to complete the road to Columbia,	805,036 54
	$1,964,991 88

Deduct bonds and notes in hands of Treasurer, which may be available,	127,872	
Amount of the sterling bonds, still in deposit with our bankers in London, at their par value,	51,111	
	——	178,983 00
Leaving to be provided for, ultimately,		$1,786,008 88

Though the subscription lists exhibits some 80,000 share owners, there are represented in the South Western Railroad Bank, but 51,198 shares held in the State of South Carolina; 14,409 held by the State, city of Charleston, and other incorporations; and 37,689 by private individuals; on 37,000 of which two instalments in bank, amounting to 25 dollars have been paid. It is assumed, therefore, that all who have advanced that much in cash, over and above payment on the road, will not hazard the forfeiture of the stock made so valuable by the amounts already paid in. We may safely presume therefore, on 50,000 shares, as the number on which will be paid all the instalments as they accrue. As yet there has been a call of but $30 on each share for the road, and a large portion of this has not been paid; leaving arrearages on the 3d, 4th 5th, and 6th instalments which cannot fall short of 150,000 00

Six more instalments, of $5 each—$30, or $60 in all, on each share, ought, on 50,000 shares, to yield $1,500,000 less 90,000 already paid in advance by State and corporations,	1,410,000 00
	$1,560,000 00
Deficiency, which can be met from the receipts of the road,	226,008 88
	$1,786 008 88

As a proportion, however, of the above liabilities are not pressing, and the debt to the State may be deferred by paying interest; and as the amount of work yet to be done, will be paid in obligations at 12 months date; and arrangements for the iron, from Europe, can likewise be effected on time; we repeat, that if the arrearages due on instalments are paid, and the four calls, now made by advertisement, on the stockholders, are promptly met, that the two addiional sums of $5 each, to make up $60 on each share, already paid in, the larger amount has been absorbed, in mee ng the purchase of the Hamburg road; and no small sum expended on surveys in anticipation of the road progressing hereafter beyond Columbia. But a very small proportion, therefore, of the payments made, have been available in the construction of the road between Branchville and Columbia. Most of the work, hitherto, on that section, has been accomplished on credit and loans, which will explain the past indebtedness of the Company to the banks; and latterly, through the agency of our obligations, in the form of promisory notes, which have thus far performed their functions most satisfactorily; and, without the aid of which, we should have been forced for the season to suspend operations. The increasing confidence which has been reposed in this paper, must stimulate our stockholders to meet their engagements for instalments as called in; and our obligations honored, as they will be at maturity, will leave the Company in possession of two hundred and two miles of Railroad, which will have cost, and is intrinsically worth five millions of dollars; on which there will be due only a deferred debt of two millions; subject to an interest, annually, of but 5 per cent. The receipts on the entire line of road not falling short of seven hundred thousand dollars, at the close of the first year after completion; and most probably increasing, in time, to eight or nine hundred thousand

dollars, must under an economical system of government and expenditure, yield not less than 7 per cent., dividend on the capital involved in the enterprise, appropriating to the three millions paid in by the stockholders their share; there will be left a two per cent. sinking fund on the deferred 5 per cent. debt of two millions, pledged for its final redemption. Should the opetions of the road fail in the accomplishment of this end, on which there seems not the least shadow of just apprehension, as a further security to the State of South Carolina for the guaranty of said debt, the additional sum of $40 on each share, not called in, but provided for in the charter, may be pledged to meet, faithfully this obligation. Our great difficulty is, the progressing of the unfinished road to Columbia, at a crisis of such unexampled pressure on the monied interests of our country: for the question is not to be mooted, that whenever the road is completed to Columbia, as it has been to Hamburg, that they will unitedly accomplish all our just expectations.

THE ROADS, THEIR LOCATION AND PROSPECTS.

The Louisville, Cincinnati and Charleston Railrod Company, in virtue of their own charter, and of the interests purchased of the South Carolina Canal and Railroad Company, are now in possession of all the Railroad enterprises within the limits of South Carolina, enjoying the peculiar advantages of being able to give *unity* and *harmony* of movement to the travel and transportation of the community. In one direction they have a road from the city of Charleston of one hundred and thirty-six miles in extent, completed and in successful operation, and having reached the terminus of the State in that quarter, it only awaits the progress of events *certain though slow*, of consummating a more perfect union with those numerous works, now under construction, and which have been projected with the view of intersecting the productive States of the south and west.

In another direction and diverging from the above road at Branchville, our Company have under construction a road, a portion of which has been finished, to Columbia, penetrating the interior and one of the richest portions of the State of South Carolina, and demonstrating, in its future projected extensions beyond that place, on the vallies of the upper Tennessee and of the Ohio rivers, as well as on the rich and flourishing mineral and manufacturing districts of North Carolina.

It is not to be credited, that in the successful accomplishment of this first section of a grander design, the greater enterprise, (in the progress of events, and in times more propitious than the present,) will be permitted to fail, through the indifference or want of support on the part of the citizens of other States, equally as interested as those, who have put forth their strength at the commencement.

It is due, however, to the States of North Carolina, Tennessee and Kentucky to call the attention of their citizens to the resolution passed at the last annual meeting of this Company at Ashville, in which it was declared, "that this company now reiterate their declaration, that without the united assistance of the States through whose territories the road is to pass, the work cannot be accomplished, and they now make their solemn appeal to those States, and are compelled to declare, that unless they speedily and cordially co-operate, this Company will be unable to progress with the enterprise."

The location of these roads, that to Augusta and Hamburg in one direction, and to Columbia in the other, and commencing at the most populous commercial city, and at the most accessible harbor south of the Chesapeake, is peculiarly advantageous. They form, as it were, the centre links in a

chain of Railroad and steamboat transportation, on which have commenced and, as certain as the tides at their appropriate seasons, will continue to ebb and flow, the moving and enterprising population and interior trade of these States, from the most eastern to the most southern and western extremity of the country.

The chain of roads and steam navigation from Salem and Boston via. New York, Philadelphia, Baltimore and Washington, the Fredericksburg, Richmond and Petersburg, and the Portsmouth, Roanoke and Wilmington roads has already been completed. Branching from the Roanoke by a more interior direction, and another chain has been commenced via. Gasson and Raleigh in North Carolina, which in the progress of enterprise and improvement, must in time, force its way by the Bend of the Yadkin, or by Fayetteville, Cheraw, and Camden, to its junction with our road, either at Columbia, or at or near the viaduct over the Congaree, pursuing in its course the line designated and projected in the map of the United States as the *Metropolitan Route.* In the south and west, the map exhibits traces of roads in Georgia, Tennessee, Alabama and Mississippi, no less important, and equally dependent upon one great design, of *general intercommunication among the States.* First, from Savannah in a direction to Macon and Augusta, ninety miles of which has been completed. Second, from Augusta to Decatur on the Chattehoochee ridge, one hundred and sixty-five miles, one hundred and eight of which is in a finished state. Third, from Macon, via. Forsyth, to the same point, all of which is under graduation;—and fourth, the Georgia State, or Atlantic and Western Railroad, from Decatur the termini of the above roads, to Ross' landing, or Chattanooga, on the Tennessee river, a distance of one hundred and thirty miles, the whole of which has been located, and the graduation of most of which is in a very advanced state. With the same views, and aiming at the same central point of connection, we see in Alabama a road commencing at Montgomery, 25 miles of which is completed, in progress towards West Point, on the Chattahoochee, with a further object of uniting at Covington, or at Decatur, with the Georgia, and the Western and Atlantic Railroads. In Tennessee a successful effort by the Hiwassee Company, from Knoxville, tending towards the same point. At Memphis, on the Mississippi, a road to La Grange, 57 miles, has been commenced, most of it has been graded, and the whole in progress of completion; looking in the liberal grants which have been accorded by the States interested, to an ultimate union with the road, now completed, and under operation, from Tuscumbia in North Alabama, to Decatur, on the Tennessee river. In a more southerly direction, a new line has been projected, and the initiatory steps taken for its execution to unite the Montgomery and West Point road in Alabama, via Selma, with Jackson, Vicksburg and Natchez, in the State of Mississippi. Other projects by which Railroad communications between the roads enumerated, and Apalachicola, St. Joseph's, Pensacola, Mobile and New Orleans, are under examination, and will no doubt receive in time, the favorable action of those interested. All these roads, crossing as they do, the great rivers flowing through the south and west, at points accessible to an ascending and descending navigation, make those streams tributary to the more extended commercial intercommunication the roads are designed to promote.

The line, however, of South Western Railroad, and steamboat transportation, which has been long projected, now attracting much interest, and which is nearest to completion, is that by Augusta and the Tennessee river to Memphis, on the Mississippi. Of the above distance, 579 miles, from Augusta to the Mississippi, there is 145 of Railroad transportation, and

130 of steam navigation, now in use; 187 of Railroad, under construction, and rapidly advancing to completion, and only 117 miles of Railroad though projected, located, and in part provided for, which has not been commenced. The peculiar feature, however, of this route, and which most strongly recommends it, is, that by a peculiar deflection to the south of the Tennessee river, known as the Big Bend; the navigable waters of the Mississippi, *are actually brought within* 295 *miles of Augusta*, on which line there remains but 57 miles of Railroad, which has not been commenced, but which has been located, and it is believed will soon be under contract. The avenue to that river, thus opened by the energies and enterprise of the State, and citizens of Georgia, at once consummates in one direction, the so much desired connection between the east and the west. The Tennessee river is reported by the United Engineers, who have carefully examined it, as a navigable stream bearing a favorable comparison with that of the Ohio; and as the navigation is equally as good to Ross', as to Gunter's landing, the terminus of the Alantic and Western Railroad, at the former, saves the difference of distance between these points. In an able and interesting report of the Canal Commissioner to the Alabama Legislature, charged with the improvements on the Tennessee river, now in progress, we make the following extract:—"The river in average years discharges about the same quantity of water as the Ohio, with the exception of the obstructions at, or near the Muscle Shoals, which may be canaled through the whole extent for less than has been expended on the falls of the Ohio, at Louisville; it is equally adapted to navigation in an extent of 600 to 800 miles, with the additional advantage of exemption from ice, which causes frequent interruption to the navigation of the Ohio, at irregular intervals from November to March." The obstructions therefore, at the Muscle and Colverts Shoals, and some other points which have been examined and for which there have been liberal appropriations on the part of the General Government, removed; and an uninterrupted navigation for steamboats may be obtained from the terminus of the Georgia road at Chattanooga, and by a descending current, to the valley of the Ohio. That all these projects, originating in different States, and by independent companies, as parts of one general design, will in the course of time be finished, we have the guarantee of the enterprise of the age, and of the wealth and productiveness of the countries they are intended to intersect, and accommodate. Most of the Railroad projects in particular will be accomplished. They have advanced too far to halt, and every day's experience seems to confirm the popular feeling in their behalf. For speed and security, they stand unrivalled; there is but one further improvement requisite, the diminution of the cost of construction, and of management, to confirm the universal preference awarded them. To this all important subject too much of the attention of Engineers cannot be directed. The stimulus to internal improvement, and to private enterprise by Railroads, has received its principal check from unanticipated expenditures. The splendor of a road may gratify the eye, but those who build, and have to sustain them, will calculate the cost, and it must be ever held in mind, that the expense of freight and passage must vary with. and bear a relation to the capital involved in the construction. As you diminish both, the power to cheapen transportation is enlarged, and thus a perference for Railroads in the community, will be extended and confirmed.

These representations of what has been done in the south, of what is in progress, and of whnt remains to be accomplished, must forcibly impress all how dependent these avenues of intercommunication for success, must be on each other. Whatever may be the opinions now in conflict on this

subject, however, local jealousies may for a time engender most mistaken rivalship, yet more liberal and enlightened views, must bring all the stockholders, and managers of Railroads, to the same common ground; that like the veins, and arteries of the human, they are in the physical and commercial world, but parts of one system, the circulation on the one, depended on, and contributing to the circulation on all: The cities of the south and west, can never in justice be jealous of each other's prosperity. They are relatively dependennt on each other, and should that connection by railways with the Tennessee river be consummated, as it no doubt will, there will be a stream of south-western trade and travel, not a subject of strife, between sister cities and roads, but of most abundant participation for all. The inquiry, in the overflowings will be, not who has too little, but who desires more. Can this be deemed extravagant with the facts, which the history of the past affords. When three such cities, as New York, Philadelphia and Baltimore, without including in the exhibit stars of a smaller magnitude, revolving in the same sphere, and by the same impetus power, all within a circle of two hundred miles, and numbering more than half a million of inhabitants, have grown, and continue to increase, and gather strength from the contributions of that mighty empire west, which like a giant, has sprung from its cradle. When a fourth and no less popular city, at the very eastern extremity of the Union, is now pressing forward with its great Railroad, not to *intercept*, but to participate in this trade, more than enough for all. Can the cities of the south doubt, that while neither can appropriate to itself, they may all enjoy, and in abundance, their fair share in the division if they but unite in the means, where union is necessary to its accomplishment. If the North River Canal, the works of improvements in Pennsylvania and Maryland, have already been so influential in encouraging a western trade with the cities of the north and middle States, what may we not confidently calculate upon, when the waters of the Mississippi, are made to flow, as it were, by a shorter and more natural channel, and on a parallel of latitude not to be impeded by the snows, or congealed by the ice of winter. Commerce is not local, and abhors monopoly full as much as nature does a vacuum. It may for a time be paralzed by ill advised restrictions, but in the alasticity of its nature, it will seek avenues of circulation, however impeded and however circuitous. Give it, however, facilities, clip not its wings, and with the speed of the locomotive, it will find its way, in every direction, and apportion to each section of the world, its fair proportion of the interchanges it encourages. A just comprehension of the relations, and of the mutual dependence of the parts, on a universal system of commercial and extended intercourse, must irresistibly lead to the acknowledgment, that to the freedom of trade, as to the liberty of action, must we look for the stimuli to great enterprises.

Impulse has been given by the independent action of States and corporations in every direction, and it is now only necessary to harmonise, and to combine, and to concentrate the energies of each, free from the repulsive spirit of supposed, or mistaken rivalship, to accomplish the ends all aim at.

Respectfully submitted by

JAMES GADSDEN, President, &c.

American Copper.—We are gratified to learn from a late number of the Wisconsin Enquirer, that Messrs. W. Alford and P. W. Thomas of New Baltimore in that territory, have met with complete success in their experiment on smelting copper ore. They constructed a very simple furnace which cost only ten dollars, in which they smelted on the 28th of Sep-

tember last, 2,500 pounds of ore, from which they obtained nearly 700 pounds of good pig copper, pronounced, by competent judges, to be superior to the South American pig copper. The time occupied in procuring from the ore the above amount of copper, was only nine hours. Neither Mr. Alford nor Mr. Thomas had had any experience in the business of smelting, and the result is justly deemed a matter of great consequence to that Territory, which abounds in rich copper ore.

We import over three millions worth of copper annually, which we hope ere long to obtain from our own mines, while we export largely this valuable metal.

RAILROADS IN THE UNITED STATES. By Chevalier De Gerstner.

RAILROADS IN ALABAMA, LOUISIANA, MISSISSIPPI, TENNESSEE, AND KENTUCKY.

(Continued from page 301.

The railroads in these five States also pass more or less through sections of country very thinly settled, and are with some exceptions of a less substantial construction, and with the limited means of the companies, the time of their completion may yet be far distant.

The railroads undertaken in *Alabama* appear very extensive, if the small population of this State be taken into consideration. Only one of the lines, however, that from Decatur to Tuscumbia, has been opened.

The railroads in *Louisiana* are all very short, with the exception of the New Orleans and Nashville railroad; they nearly all terminate at some point on the Mississississippi river, and like the railroads in the adjoining State of Mississippi, from lateral branches to this great highway of the west. To some of the railroad companies in Louisiana, loans were granted by the State, while others have obtained bank charters.

In *Mississippi* the railroads are constructed at a considerable expense by companies with banking privileges. The longest line is that from Natchez to Canton.

Two railroads are in progress in the State of *Tennessee*, but no part of them has yet been opened; and in *Kentucky* only 32 miles of railroads are in operation. In the latter State a considerable sum has been expended for the improvement of rivers, turnpike roads, and the Louisville and Portland canal.

The railroads in *Alabama* and *Louisiana* have not an uniform width of track; on most, however, it is 4 feet 8½ inches. The New Orleans and Nashville railroad has a clear width of 5 feet 6 inches. The width of track of the railroads in *Mississippi* is 4 feet 10 inches.

It appears that there are 27 railroads in the above five States, of which only 195 miles are completed and in operation, while their total length, when finished, will be 1148 miles. 33 locomotive engines are used upon 195 miles of roads, which gives one engine for 6 miles; the greatest number of locomotives is upon the Ponchartrain railroad, that is, 5 for 7½ miles, or 1 for 1½ miles of road.

Of the total cost of the railroads, which will be $19,234,000, one-half has already been expended, and only one-sixth of the whole length is in operation. This shows that the works on many railroads must have been suspended, when they were already far progressed. The average cost of the railroads in these five States will be $16,750 per mile, which does not differ much from the cost of the railroads in Virginia, North and South Carolina, Georgia, and Florida.

RAILROADS COMPLETED AND IN PROGRESS IN ALABAMA, LOUISIANA, MISSISSIPPI, TENNESSEE, AND KENTUCKY.

No.	Name of Railroad.	From and to where	Opened. Year.	Opened. Miles.	No. of miles. Besides graded.	No. of miles. Not yet constr'd.	Total length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion	Total cost of road.	Cost per mile.
1	Montg'y & West Point,	Montgomery to West Point.			65	20	85	plates $2\frac{1}{2} \times \frac{5}{8}$		200,000	700,000	900,000	10,590
2	Wetumpka and Coosa,	Wetumpka to Fort Williams.			35	21	56	"		50,000	566,000	616,000	11,000
3	Selma and Tennessee,	Selma to Gunters' Landing.			27	143	170			180,000	1,570,000	2,650,080	9,700
4	Cahawha and Marion,	Cahawba to Marion.			27		27			50,000			
5	Linden and Demopolis,	Linden to Demopolis.			10	12	22			25,000			
6	Mobile and Cedar Point,	Mobile to Cedar Point.	1837	5	4	$17\frac{1}{2}$	$26\frac{1}{2}$	" $2 \times \frac{5}{8}$	1 locomot.	117,000	183,000	300,000	11,320
7	Tuscumbia, Courtland and Decatur,	Decatur to Tuscumbia,		46			46		2 "				
1	Pontchartrain,	N. Orleans to Lake Pontch.	1831	$4\frac{1}{2}$			$4\frac{1}{2}$	24&56 lbs.	4 "	356,000		356.000	79,110
2	N. Orleans & Nashville,	N. Orleans to Miss. State line.	1839	$22\frac{1}{2}$		66	$88\frac{1}{2}$	$3 \times 1\frac{5}{8}$	3 "	970,000	800,000	1,770,000	20,000
3	Bath,	New Orleans & Nashville R. R. to Lake.	1837	$1\frac{1}{4}$	2	$2\frac{3}{4}$	6	$2 \times \frac{3}{8}$	horses	50,000			
4	Carrolton,	New Orleans to Carrolton.	1837	$7\frac{1}{4}$			$7\frac{1}{4}$	$2\frac{1}{2} \times \frac{3}{4}$	5 locomot's	500,000		500,000	68,965
5	Orleans Street,	In New Orleans.		$1\frac{1}{2}$			$1\frac{1}{2}$	$2 \times \frac{1}{2}$	horses				
6	Lake Borgne,	New Orleans to Lake Borgne.	1838	5		20	25	$3 \times 1\frac{5}{8}$	1 locomot.				
7	Alexand'a & Cheneville,	Alexandria to Cheneville.	1839	6	10	14	30		2 "				
8	Baton Rouge & Clinton,	Baton Rouge to Clinton,				30	30			16,000			
9	Clinton & Port Hudson,	Port Hudson to Clinton and Jackson.	1839	14	14		28	$2\frac{1}{2} \times \frac{7}{8}$	3 "	400,000	100,000	500,000	17,857
10	West Feliciana,*	Bayou Sara to Woodville.			20	8	28	$2\frac{1}{4} \times \frac{5}{8}$	2 "				
1	Mississippi,	Natchez to Canton.	1839	25	15	100	140	40 lbs.	4 "	1,550,000	19,50,000	3,500,000	25,000

* 7 1-2 miles of this railroad are in the State of Mississippi.

RAILROADS IN ALABAMA, LOUISIANA, MISSISSIPPI, TENNESSEE, AND KENTUCKY.—Continued.

No.	Name of railroad.	From and to where.	Opened.		No. of Miles.		Totol length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion.	Total cost of road.	Cost per mile.
			Year.	Miles.	Besides graded.	Not yet contr'd.							
2	Vicksburg and Jackson,	Vicksburg to Jackson.	1839	25	20		45	42 lbs	4 locomot's	1,600,000	160,000	1,760,000	39,111
3	Jackson and Brandon,	Jackson to Brandon.			12		12			30,000			
4	Raymond,	Vicksburg R. R. to Raymond.			6		6	$2 \times \frac{5}{8}$		30,000	20,000	50,000	8,333
5	Grand Gulf &Pt. Gibson	Grand Gulf to Port Gibson.			7	$\frac{1}{2}$	$7\frac{1}{2}$	50 lbs.					
1	Hiwasse,	Knoxville to Georgia S'te line.			70	27	97						
2	Lagrange and Memphis,	Lagrange to Memphis.			40	10	50	$2\frac{1}{2} \times \frac{5}{8}$					
3	Somerville Branch,	Lagrange & Memphis R. R. to Sommerville.			10	$3\frac{1}{2}$	$13\frac{1}{2}$	$2\frac{1}{2} \times \frac{5}{8}$		200,000	300,000	500,000	7,874
1	Lexington and Ohio,	Lexington to Portland.	1835	$30\frac{1}{2}$	27	37	$94\frac{1}{2}$	$2\frac{1}{4} \times \frac{5}{8}$	2 locomot's	935,000	1,250,000	21,85,000	23,122
2	Portage.	Bowling Green to Barren riv.	1837	$1\frac{1}{2}$			$1\frac{1}{2}$	$2\frac{1}{4} \times \frac{5}{8}$	horses	12,000		12,000	8,000
27				195	421	$532\frac{1}{4}$	$1148\frac{1}{4}$		33 locomot's				

This statement does not contain the cost of every railroad in progress, and the amount which has already been expended, because of some it was difficult to obtain correct data, on account of the lines being located in remote parts of the States, while others have yet made very little progress, and their ultimate cost is therefore hardly known. In the following table, which contains the aggregates for each State, the deficiencies were made up by estimates founded upon a knowledge of the nature of the works and their plan of construction.

Name of State.	No of railroads	No. miles in operation.	Total length of road	No. of locomotives.	Am't of capital expended.	Am't necessary for completion.	Total cost of railroads.	Average cost per mile.
Alabama,	7	51	$432\frac{1}{2}$ miles	3	$1,222,000	$3,434,000	$4,656,000	$10,763
Louisiana,	10	62	$248\frac{3}{4}$ "	20	2,862,000	1,834,000	4.696,000	18,880
Mississippi,	5	50	$210\frac{1}{2}$ "	8	3,490,000	2,240,000	5,730,000	27,221
Tennessee,	3		$160\frac{1}{2}$ "		1,100,000	855,000	1,955,000	12,180
Kentucky,	2	32	96 "	2	947,000	1,250,000	2,197,000	22,885
	27	195	$1148\frac{1}{4}$ miles	33	$9,621,000	$9,613,000	$19,234,000	$16,750

MESSRS. EDITORS—*The progressive increase of traffic on railways,* is presented in the following report, which must claim the attention of your readers and should inspire capitalists with confidence in this class of investment. *Celerity and certainty of arrival,* will, in all countries, claim the preference, and in none is it more clearly exemplified than in the United States. If we are correctly informed, the steamboats on lake Erie have rapidly increased, and at extra prices, are taking a large portion of the trade and trafic from the sail vessels. The same results took place on the Hudson by the introduction of vessels towed by steam. May we not expect on the land from railways, and the improved locomotive, a like result? We think so. All experience at home, and abroad tend to convince us, that railways are destined to superceed canals, in high latitudes, in the transportation of merchandize, and valuable produce. J. E. B.

From Baron Charles Dupin's Report on the Paris and Orleans Railway.—Experience has proved both in France and abroad, that in a short space of time the facility, expedition, and economy afforded by railways more than doubles the number of passengers and the quantity of merchandise.

In order to support such statements, we will quote the following facts relative to the railways of Belgium, England, and Scotland in positions of extreme difference, and giving rise to a variation in the returns which far exceeded all anticipation.

Comparison of the number of travellers conveyed daily throughout the whole or a portion of the line.

Railways.	Before the establishment.	After the establishment.
Manchester and Liverpool	400	1,620
Stockton and Darlington,	130	630
Newcastle and Carlisle,	90	500
Arbroath and Forfar,	20	200
Brussels and Antwerp,	200	3,000

Increase of the number of passengers by the establishment of a railway.

Liverpool and Manchester,	300 per cent.
Stockton and Darlington,	380 per cent.
Newcastle and Carlisle,	455 per cent.
Arbroath and Forfar,	900 per cent.
Brussels and Antwerp,	1,400 per cent.

Thus, even taking as a criterion the road on which the proportional increase is least of all, we still find that the number of passengers will increase, not only 100 but 300 per cent. The transport of merchandise will experience a similarly rapid increase. We may judge of this by the progress which has been made in *the conveyance of merchandise in French steam vessels, a conveyance of much greater expense than by railway.*

Progress in the conveyance of Merchandise by Railway compared to that of Passengers.

Years.	Passengers.	Tons.
1834	924,063	22,909
1836	1,248,552	161,501
1838	1,535,189	274,808

Thus, while the number of passengers has increased 60 per cent. in four years, in the same time the quantity of goods increased 1,100 per cent.

We are indebted to Mr. P. P. F. De Grand for a number of interesting items of Railroad statistics.

Low Fares, and Low Rates of Freight, Increase the Net Revenue of Railroads.—This is found to be the case, on every Railroad, where the trial has been made, in Great Britain, France and Belgium. Such is the result of searching inquiry, instituted by the French and other governments, and by the large and highly respectable parliamentary committee in England.

Increase of Passengers, by Lowering the Fare.—Extract from the official report of Edmund Teisserenc, (charged by the French government, with the duty of making a study of the railways in Great Britain) to the Minister of Public Works.

"I have before me the statements which were issued as a basis for the subscriptions to the English railways. I find at that time (before the railways were built) the number of passengers was:—

Between New Castle and Carlisle,	per annum,	5,102
Between Liverpool and Manchester,	"	164,250
Between London and Birmingham,	"	488,382

The railway between New Castle and Carlisle, has reduced the fare to one-third of the old fare and the number of passengers has increased 900 per cent.

"The railway between Liverpool and Manchester has reduced the fare one-half, and the number of passengers has increased 200 per cent.

"The railway between London and Birmingham, has left the price about the same, and the number of passengers has increased only 10 per cent.

The above official report is published in the February number of the Journal for Public Works, published in Paris, by a Society of Civil Engineers. It shows the wonderful effects of low fares, in creating travelling. It furnishes the following statistical result:

Fare reduced 66 per cent.	Passengers increased	900 per cent.
Fare reduced 50 per cent.	Passengers increased	200 per cent.
Fare not reduced,	Passengers increased	10 per cent.

Boston Evening Gazette, Nov 7.

Railways—Great Dividends.—Extract from a late official report, on English railways, made to the French Government, by Edward Teisserenc, its agent, charged with the special duty of making a study of these railways:

"The Darlington railway has produced, by its low rate of passage and of freight, a complete revolution, in the region of country which it traverses. It has increased the value of land 100 or 200 per cent. By these low rates, the freight, estimated at 80,000 tons, has been increased to 640,000 tons—the passengers, estimated at 4,000, have been increased to 200,000.

The above extract will be found p. 80 of the February 1840 number of the Journal of Public Works, published in Paris, by a Society of Civil Egineers.

N. B. The following extract, relating to the same railway, is from the 2d Report of the Railway Committee to the British Parliament, p. 189:

"Question 4476. What dividends have you paid? Answer: The original dividends were 4*l.* They rose to 6*l.* per share, and afterwards to 11*l.* The last two years, they have been 14*l.* per share, subject to reserve of 4*l.* dividend, as a sinking fund.

Question 4477. On a share of 100*l*? Answer: Yes.

Question 4478. All your shares are 100*l.* shares? Answer: Yes.

Question 4480. What is the present value of a share? Answer: 260*l.* was the last sale in the market.

The Company charge, on coal exported (as per p. 188 and 189, questions 4457, 4465, 4468, and 4471) 1d per ton, per mile, less 15 per cent. and charge 6d per ton for ascending and descending the inclined plain, less 15 per cent.; or, only 2d for descending inclined plain, and also 2d per ton for wharfage and putting on board the vessel.

They charge (as per p. 400) per passenger, since May 1, 1838, as follows:

1st class, 1 1-2d per mile, equal to 3 cents per mile.

2d class, 1d per mile, equal to two cents per mile.

3d class, 1-2d per mile, equal to 1 cent per mile.

For the 1st 3 months of 1838 and for 1839, we find the following result (as per p. 400.)

1839—Fare, at the above prices, for 53,361 passengers, 1,622*l.* 5s. 9d.

1838—Fare, (1 cent per mile higher than above, on the 1st and 2d classes,) for 32,628 passengers, 1,273*l.* 2s. 7d.

The above charges, for freight on coal, are equal to $2 per ton of 2240lbs. for 100 miles, including the use of stationary engine, the wharfage, and putting the coal on board the vessel.—*Boston Traveller, Nov.* 6.

Low Fares in Public Conveyances and at Taverns.—We have received from a friend the subjoined statement on the effect of making the fares on railroads and public conveyances as low as may conveniently be done. This is only one among innumerable examples in respect to public conveyances where the same result has followed; and the cheaper the fare the greater has been the profit. There is a point, to be sure, below which one would not think of going; but the great mass of every community, embracing about seven-eights of them, are obliged to calculate very closely as to what they can afford; and will be induced to travel when the fares are very light, when they would never think of doing it while fares are high, or considered high. This applies especially to short distances. We have no doubt whatever that if, for eight months in the year, the fare from Boston to Salem was twenty-five instead of fifty cents, from Boston to Lowell fifty cents instead of a dollar, from Boston to Worcester one dollar, instead of one dollar and fifty cents, and from Boston to Providence one dollar, the travel on every one of these routes would be quadrupled. We saw a proposition a few days since, from a gentleman whose authority is entitled to great respect, to raise the fare from Boston to New York to, and to fix it permanently at six dollars, instead of five. For those who travel undoubtedly the fewer passengers the more comfort; but for the profit of the companies, no measure could be more ill-judged. We have no doubt, for six months in a year, if they would carry passengers from Boston to New York for three dollars instead of six, and this might be easily and safely done in boats which should make the whole passage by daylight, the receipts of the company would be double what they would be at six dollars. The same remark applies likewise to public houses. If at the stage dinner houses, for example, the dinner was charged at twenty-five cents, and this in most places can be well afforded, scarcely a passenger would fail to dine. Now the price being fifty cents, not one passenger in six takes any dinner. This may be seen on Railroads. In travelling from Boston to Springfield, at Framingham, at Worcester and at Warren, there is an almost universal rush to the tables, even with passengers who having breakfasted in Boston, to get a lunch or refreshments, which they do, often times, at great personal inconvenience, for 12½ or 25 cents. If the

breakfast or dinner were half a dollar, though it might be even much better than it is, not one in ten would think of taking it. So it is in stage coaches, as every man who travels much, may soon discover, if he will but make careful observation of the case. A few weeks since, where we were travelling in a stage coach with six passengers, two only took breakfast at the stopping place; the other four remaining in the stage, simply because they would not pay fifty cents for a breakfast, which they knew in that place was about four times its actual cost, or because the could not afford it. They avowed the charge for the meal to be the reason why they would not partake of it; and if you could come at the truth in other cases, in a great majority of them this would be found to be the true cause of their abstinence.

ULSTER RAILWAY—(8 MILES.)

(From the Fifth Report to the British Parliament on Railways—p. 428.)

1st class, 17,931 passengers at 1 1-2d., equal to 3 cents per mile,	895*l.*
2d class, 166,690 passengers, at 3-4d., equal to 1 1-2 cent. per mile,	4,167
Together, 184,621 passengers,	5,062*l.*

It is thus very clear that more than four-fifths of the revenue from passengers comes from those who pay 1 1-2 cent. per mile.—*Boston New England Farmer, Nov.* 18.

Edinburg and Dalkeith Railway—Eight and a Quarter Miles.—From Fifth Report to the British Parliament on Railways, page 339 to 343. Receipts for passengers for nine months ending January 31, 1840.

For first class, 1 3-4 per mile, equal to 2 1-2 cents per mile.

1839.	May, 278 passengers,	11	11	8
	June, 432 "	18	00	0
	July, 261 "	10	17	6
	Aug. 347 "	14	9	2
	Sept. 250 "	10	8	4
	Oct. 184 "	7	13	4
	Nov. 178 "	7	8	4
	Dec. discontinued for want of passengers,	00	0	0
Together	1930 at 2 1-2 cts. per mile,	80*l*	8	4

Receipts for the said period for passengers 2nd class 1 1-20d. per mile, equal to 2 1-10 cents per mile.

1839	May, 21,987 passengers,	610	7	5
	June, 26,714 "	720	4	8
	July, 30,041 "	753	5	9
	Aug. 34,468 "	880	12	6
	Sept. 22,461 "	578	12	0
	Oct. 18,299 "	494	17	10
	Nov. 21,129 "	581	9	9
	Dec. 12,290 "	334	7	3
1840	Jan. 14,734 "	403	8	9
Together	202,223 " at 2 1-10th	5,357*l.*	5	11

It will thus be perceived, that nearly the whole revenue of the road was derived from passengers paying 2 1-10th cents per mile; and that the revenue from passengers taxed higher, was so trifling, that their class was discontinued.

During the year 1838, the fare was 1st class 1 1-8d per mile. 2d class 7-8d per mile.

During the year 1839, the fare raised to 1st class 1 1-4d per mile. 2d class 1 1-20d per mile.

Number of passengers		1838—299,201	at the original fare.
do.	do	1839—249,066	at the increased fare.

Loss of pass. by the higher fare 50,135 besides the annual increase, natural to this and all other Railroads.

Belgian Railroads.—From Michel Chevalier's very valuable work on the internal improvements of the U. S. &c., published in Paris and in London. Vol. 1. p. 379:

THE FARES, on the Belgian Railroads were, at the very outset, placed *extremely low.* Instead of an increase of 4 to 1, as had been the case on many lines the INCREASE of passengers, between Brussels and Antwerp, was 15 to 1. But at the end of 1838, the sections then most recently opened being but little productive, the administration became alarmed and *the fares were raised on the 20th Feb,* 1839, still leaving them however at very low rates. *The immediate effect of this rise of fares was to diminish the number of passengers to such a degree that the revenue was less than at the original fares.* Without waiting any longer, the administration, judging itself sufficiently enlightened, tried, in the month of July 1839 a new experiment. It doubled the number of trains upon all the lines and divided them in two classes—one class (the quick trains) stopping only at stations of the first order and the other class (the slower trains) stopping more frequently and going at the same speed as the quick trains, from which speed must be deducted the time lost, by the more frequent stops. It kept up the rate of fares of the 20th February 1839, for the quick trains. But, for the slower trains, it came down, to the original fares. This modification instantly lifted up the receipts to an amount above that at which it stood before raising the fares.—*Boston Evening Gazette, of Nov.* 14.

Garnkirk and Glasgow Railway, (opened at the end of 1831.) [From the Railway Times, of Febuary 22, 1840.]

	No. of passen's.	Receipt for passen's.	Total Recipts.
1832	72,605	1,717*l*	6,476*l*.
1833	96,003	2,440	7,254
1834	117,743	2,985	8,413
1835	136,724	3,438	9,311
1836	145,703	3,850	10,324
1837	119,460	3,803	11,839

By the above, it will be perceived that there is, every year, a regular progress onward (until 1836 inclusive) as regards the number of passengers, the receipts from said passengers, and the total receipts. It will also be perceived that the total receipts still moved onward in 1837.

The question naturally arises, what was it that arrested, in 1837, the onward march in the number of passengers, and in the receipts of said pasengers? We find the problem solved by the Fifth Report to the British Parliament, page 233. The reason is there stated to be that "the fare was raised 33 1-3d per cent., in the beginning of 1837, without any diminution of the expense of running the road."—*Boston Transcript, of Nov.* 6.

Dundee and Arbroath Railway.—Opened 16 miles, June1, 1839. Receipts for passengers for 7 months, ending 30th April, 1840;—1st class—

10,713 passengers, at 2d. per mile, equal to 4 cents per mile, 668*l.* 18s. 7d; 2d class—14,870 passengers, at 1 1-2d per mile, equal to 3 cents per mile, 1,148*l.* 7s. 2d; 3d class—61,876 passengers, at 1d per mile, equal to 2 cents per mile, 2,221*l.* 10s. 5d.

The above is to be found p. 323 of 5th report to British Parliament, and shows that three-fourths of the passengers, giving more than half the revenue, paid only 2 cents per mile.—*Boston Courier of Nov.* 14.

London and Greenwich Railway.—We find by the Monthly Chronicle, Boston, Sept. 1840, page 330, that the Greenwich Railway was opened to Deptford, Dec. 14, 1837, 3 miles, and through the whole length to Greenwich, Dec. 24, 1838. We also find (pages 378 and 379 of the 5th British Parliamentary Report) that this whole length to Greenwich is 3¾ miles. It is therefore very natural that the income of 1839, for 3¾ miles, should be more than the income of 1838, for 3 miles. When asked by the Parliamentary Committee, whether they have raised or lowered their fare, there reply is (see p. 379) as follows:—

"Since the Greenwich Railway has been opened, the whole distance to Greenwich, which took place in Dec. 1838, the fares have been without alteration."

It follows clearly from these premises, that *the opponents of low fares are in error*, when they produce, as *an argument for high fares*, the statement "that the London and Greenwich Railway passengers paid for 11 months of 1838, at 6d, 35,770*l*, and for 11 months of 1839, at 8d, 42,247*l*.

Surely nothing can be more natural than to find a road of 3¾ miles, charge higher for 3¾ miles than it did for 3 miles. Nothing can be more natural than to find 3¾ miles, in 1839, produce more receipts than 3 miles in 1838.—*Boston Morning Post, of Nov.* 16.

Eastern Counties Railway—open 10½ miles. Receipts for passengers for 8 months, ending 31st January, 1840:

1st class, at 3d per mile, equal to 6 cents per mile, 10,574 passengers,	1,087*l.* 0 6
2d class, at 1 4-5d per mile, equal to 3 3-5 cents per mile, 66,954 passengers,	3,678 5 6
3d class, at 1 1-4d per mile, equal to 2 1-2 cents per mile, 104,508 passengers,	4,003 44 9

The above is from the 5th Report to the British Parliament, by the Select Committee on Railways, page 337. It shows how trifling is the number of travelers who elect to pay the first class price—*Boston Mercantile Journal, of Nov.* 14.

Loss of Money by Raising the Fare, and Gain of Money by Lowering the Fare.—From the official report of Edmund Teisserenc, to the Minister of Public Works in Paris, dated 15th June, 1839, and published in Paris. Pp. 345, 348 and 349.

Belgian Railroads.—Mean receipts per day, for each section:—

1838.—March,	859	francs.	At the original fare.
April,	950	do.	
May,	1,010	do.	
Together,	2819	francs at the original fare.	
1839.—March,	700	francs.	After raising the fare about 40 per cent.
April,	900	do.	
May,	950	do.	
Together,	2550	francs, after raising the fare.	

It stands, then, before raising the fare,		2819 francs.
And after raising the fare,		2500 do.
Loss of receipts, by the higher fare, on each section, per day,		319 francs.

Saint Germain Railroad (near Paris.)

	No. of passengers.	Receipts.
1838.—Jan., Feb., and March, at the original fare,	160,542	172,515 francs.
1839.—Jan., Feb., and March, at fare reduced 25 per cent.,	236,889	189,545 do.
Thus presenting, by the lower fare, a gain, for 3 months, of	76,347 passengers and	17,030 francs. in the receipts.

Recapitulation.—The *increase* of 40 per cent. *in the fare,* on the Belgian Railroads, gave *a loss* of 11 per cent. *in the receipts.*

The *reduction* of 25 per cent, *in the fare,* on the St. Germain Railroad, gave *a gain* of 10 per cent., *in the receipts.*

By p. 655 of the above named official report, it will be seen that in regard to the Belgian Railroads, the Belgian Administration, *perceiving the loss of receipts by the rise of fare, have gone back to the original rates,* (which is equal to 4-5th of one cent per mile, for the 4th class passengers) for the trains which have been established to land and take up passengers, every three or four miles. And *Michel Chevallier,* (in his valuable work on Railroads, Canals, &c., published in Paris and London in 1840) mentions, vol. i. p. 379, *that thus lowering the fares* on the Belgian Railroad, "*instantly carried the receipts up,* to an amount *exceeding* that at which said receipts stood before raising the fares."—*Boston Atlas, of Nov.* 17.

Railways in the West.—Great as are now our locomotive appliances, they were found during the races altogether inadequate to the demand. On Thursday, the number on the joint line of railway to Glasgow amounted to 6,500, but that number might have been doubled had there been a sufficiency of carriages. Yesterday, more effective arrangements appear to have been made. There were 25 trains up and 25 down, and the number of passengers amounted to 8,200, while several thousands were disappointed. The pressure of passengers last night was tremendous; hats, and still more, ladies' bonnets, and other articles of dress, were terribly crushed, and one woman had her leg broken. Besides the passengers on the joint line, there were from 3,000 to 4,000 on the line from Ayr. At many of the hours of starting of the canal boats more was left than taken; but we cannot state the numbers, as they are not made up over night. On Thursday the number of passengers by the Renfrew railway amounted to 2,800; but yesterday vast numbers left for the water places, as well as for Glasgow, and not less than 36 trains ran, conveying nearly 6,000. The Paisley steamer started each day also, and was well patronised, having conveyed yesterday about 130 passengers up the Gareloch.—*Paisley Advertiser,*

Railroad Iron.—A London letter says: "Orders from America for railroad rails of manufactured iron, have, during the past week, been given out to the iron trade to the enormous weight of 35,000 tons; and it is anticipated when this contract is completed, others will speedily follow, though not to the present extent."

It gives us pain to see so much American money sent to England to purchase an article which is so abundant in this country as that of iron. If our own rich and exhaustless mines were adequately worked, it would furnish a great additional, and a quite reliable market for our large surplus agricultural products. We call upon our western farmers to speak out up-

on the momentous subject of providing a sure home market for the products of their industry. The condition of all foreign nations is such, that they must necessarily raise a large annual revenue to meet the interests on vast public debts, and for the support of expensive systems of government, by assessing a heavy duty on nearly all foreign products consumed by the people of those countries.

They are compelled to resort to this indirect mode of raising money, and cannot, if they desired so to do, abandon the policy of taxing our bread stuffs for the support of their oppressive monarchical, aristocratical systems. Nothing short of a total revolution, and the general refusal to pay the interest on their national debts, can enable the principal governments of Europe to adopt the much praised system of free trade. Unless the people of this Republic choose to submit to an enormous tax, without any equivalent, amounting at this time to more than two dollars on every barrel of flour sent to England to pay for railroad iron, they must meet this tax by a countervailing duty upon the products of English labor.

Whatever the price of American bread-stuffs to be shipped abroad may be reduced in value in our Atlantic cities, in consequence of the duty imposed upon them by foreign governments, such duty is to that extent a direct tax imposed upon the productive industry of this country, for the support of the Kings, Queens and Emperors of Europe. Mark well the fact, that the price of wheat and flour at all times when we have a surplus in Boston, New York, Philadelphia, and Baltimore, is governed by its value to ship to foreign countries; and that its value to ship depends in a good degree on the duty assessed upon it in foreign ports. Let no one who is not tory enough to submit to a tax for the payment of the national debt of Great Britain, and for the support of her majesty, and the established church of England, acquiesce in the impositon of a duty on the products of American industry in British ports, without a corresponding duty on the products of British labor in American ports, for the *protection* and *encouragement* of home production.

The Propeller Steamboat.—This vessel was built in the yard of Mr. Dichburn, at Blackwall. The engine by which her paddles, or propellers, as they are termed, are worked, was made by Mr. Beale, the engineer, at his premises at Greenwich. She is a small vessel, but very elegant in her proportions, and formed to cut through the water with great rapidity. The engine is of 24 horse power. The propellers differ from the paddle-wheels used by other steamers, in being single blades of iron, only one blade on each side of the vessel, and not a series of blades brought into the water by the revolution of wheels. Each blade is very broad and large, and dips almost perpendicularly in the water, so that the concussion formed by the blades of paddle-wheels dipping into the water at angles is avoided, and the consequent unpleasant vibration of the vessel.

Directly the blade dips into the water it is forced back by an arm or limb of iron, forming a motion similar to the leg and web-foot of an aquatic bird, and by means of this motion the vessel is propelled forward. She can perform from 10 to 11 knots, or miles, an hour. The appearance of the propellers is like that of the legs of a grasshopper, and when in motion their action, in some degree, resembles the legs of that insect in its walk. One great advantage is, that the propellers occasion no swell in the water, no wake or trough in the river, and no backwater, so that no danger is occasioned to small boats by the rapidity of her progress. This vessel now runs hourly between Blackwall and Greenwich, and appears to be a great favorite, from the number of passengers she is continually conveying backward and forward between these places.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 12, Vol. V.
New Series. | DECEMBER 15, 1840. | Whole No. 372.
Vol. XI.

At the close of another half yearly volume, in accordance with our usual practice we propose to address a few words to our readers in reference to what has been accomplished during the last six months, both in matters of general interest, and in those things which more particularly concern our readers and ourselves.

The latter half of the year 1840 will ever be remembered as a period of unusual political excitement, and hence unfavorable to any thing like clear and calm scientific inquiry. The depressed state of financial affairs throughout the country has continued to exert an unfavorable effect upon public works—although an improvement has been witnessed which appears to warrant hopes of still brighter times; consequently but little of novelty has been offered in the way of construction. Under all these disadvantages we have endeavored to present our readers with matters of interest and to improve the character of our work. How we have succeeded our subscribers can best determine.

The increased interest attached to the progress of ocean steam navigation has been the chief topic both in our own and foreign journals. The success of the two lines established between this port and England, and the more recent establishment of Cunard's line of mail steamers has called forth a variety of projects and a still greater variety of discussions, the latter, we regret to say, have not been the means of spreading any new light. The strict investigation of the power of steam and its application, is the only method of attaining any useful result, and of showing how much power is really lost in the necessary arrangements of machinery, by friction and otherwise.

The return of the President, caused by a deficient supply of fuel, has proved that her actual consumption of fuel is nearly if not quite ten tons per diem more than that the usual estimate, being an increase of more than 30 per cent. as her nominal consumption.

The recent surprising success of the Archimedes steamer in England has revived the prospect of the introduction of screw propellers. More experiments are necessary, however, to establish their superiority to paddle wheels.

The improvement of locomotive engines has continued to excite attention, and frequent notices of extraordinary performances appear. It is desirable that these experiments should be conducted with greater accuracy and precision than formerly, if designed to make any impression upon professional m n. The quantity of fuel consumed is seldom or ever alluded to, although one of the most important items of railroad economy. When well made engines are so nearly equal in power as they now are, it requires very nice experiments to determine which are the best.

The recent order from the Emperor of Russia for a number of locomotive engines, and the building a steam frigate for the same power, in New York, shows how high the character of American mechanics stands abroad.

To those of our friends and correspondents who have contributed to our pages we return our warmest thanks, and by leave to remind them and others that the greatest service they can render the profession, is to communicate the results of their experience.

In conclusion, we have only to say, that if supported by our subscribers and contributors, we shall be able to increase the value and variety of our articles.

VENTILATION OF COACHES AND RAILROAD CARS.

Every little while we find some hints upon this subject thrown out in various journals, but they appear to receive as little attention as the reiterated complaints of the want of ventilation in public buildings. It is really wonderful that so little is cared for an abundant supply of pure air; in fact most people seem to be perfectly ignorant of any necessity for it, and consequently express provision is hardly ever made for that which is as necessary to the lungs as pure and wholesome meat and drink for the stomach.

The season is now at hand when i most railroad cars, stoves are provided for the comfort of the passengers. The consequence is that the temperature, already nearly if not quite sufficient from the quantity f nim l heat generated, is raised to an uncomfortable degree, which the vitiation of the air by twenty to sixty lungs increased by the presence of the stove, unti lthe atmosphere becomes positively deleterious. The doors and windows which in summer are left open, are most carefully closed, and not the least opportunity is afforded for introducing a fresh supply of air. We speak feelingly of this nuisance for we travel 22 miles daily on a railroad, and our partiality for fresh *unbreathed* air, is continually shocked by an atmosphere not only uncomfortable, but positively offens ve.

The remedy for this nuisance is so simple that it is surprising that it is not universally adopted. The motion of the cars is sufficient to produce

a free circulation if the least aperture is afforded for the entrance and exit of the air. All that is necessary to be provided for is the dispersion of the cold air in its entrance in such a manner as to prevent the whole current from directly striking upon any particular seat. This can easily be accomplished by an attention to the principle that a current of air rushing into an atmosphere at rest is mixed with and dispersed through it with a rapidity proportional to the velocity of the current. A gentle draught of cold air entering a room is felt at a greater distance than a much stronger current of equal temperature, and consequently by a diminished aperture a sufficiently small current can be admitted of great velocity and so rapidly scattering as to produce no uncomfortable feelings at a short distance.

The method then of ventilating cars in the simplest manner would be to furnish a small opening in the front of the car near the top, and a similar opening directly opposite in the back end of the car. These openings should be covered with wire gauze to prevent the entrance of sparks, and provided on the outside with a shed water to keep out rain. It is plain that the air entering with such velocity at the top of the car is almost instantly mixed with the atmosphere within, while a corresponding quantity of heated and impure air escapes at the back of the car. In a long car, it would be better to provide two or more pipes ending at different places along the top of the apartment. The necessity for separate pipes will be evident, for no air would issue from any openings in the side of a pipe passing directly through the car.

We hope that the simple nature of the arrangement, which can be accommodated to all varieties of circumstances, will induce those having the control of railroads to provide for the comfort and health of passengers. The quantity of fresh air absolutely necessary to be supplied to each individual is four cubic feet per minute, and all that is short of this is as positively injurious as if the air had been poisoned by so much vapor of burning charcoal. An apartment containing 20 persons will need at least 80 cubic feet per second, and one containing 50 persons will require 200 cubic feet to be admitted each minute to maintain an atmosphere fit to support life without discomfort.

For the American Rrailroad Journal and Mechanics' Magazine.

REMARKS ON THE "LAWS OF TRADE." By C. Ellet, Jr., *Civil Engineer.* No. 4.

It has been demonstrated* that the charge for toll corresponding with the maximum revenue on the trade of any tributary of a canal or railroad, is equal to half the charge which, if exacted, would entirely exclude the article in question from the line; and that its expression for that division of the trade which is not contended for by rival works, is

$$C = \frac{\Pi - h\delta}{2h};$$

* "Essay on the Laws of Trade," page 77—86.

and that the revenue per mile which will be obtained when that charge is levied, will be represented by

$$R = t\frac{(\Pi - h\,\delta)^2}{4\,\beta\,h}.$$

By comparing these equations, and cancelling the numerators of the fractions, there will result

$$R = t\frac{C^2 h}{\beta}, \qquad (K)$$

for the value of the maximum revenue per mile derived from the trade of the branch in question, in terms of the toll, the distance, the productiveness of the country, and the cost of conveyance on the branch which furnishes the trade. It appears from this equation, of which the application is remarkably easy, that the profit due to the trade will be as the square of the charge for toll which would produce the greatest revenue, and consequently as the square of that charge which would just exclude the trade. The rule for its determination will be, *multiply together the number of tons furnished by each mile of the branch, the distance in miles from the branch to the mart, and the square of half the charge for toll which would exclude the trade, and divide by the cost of carriage per ton per mile on the branch.*

If the commodity under consideration were one for which a rival work were in competition, it would be shown by the same process that the revenue would be obtained by dividing the above product by twice the charge for conveyance on the branch.

For an application of the formula, let us suppose that it is ascertained that the annual quantity of any article produced along the Ohio is 50 tons per mile; that the main line of the Pennsylvania improvement is 400 miles long, and that the state of the markets, and other circumstances influencing the direction of the trade, are such, that if a toll of 4 cents per ton per mile were charged, the article in question would be excluded and forced down the river to New Orleans;—the charge for freight on the river being one cent per ton per mile. In this case the value of C, or the toll, ought to be two cents per ton per mile, and consequently the revenue would be

$$R = t\frac{C^2\,h}{2\,\beta} = 400 \text{ dollars}$$

per mile, or $160,000 per annum for the whole line.

It is true that there are few cases in which all the data of such a problem as this could be ascertained with sufficient accuracy to permit a very correct estimate of the probable revenue; but if we do presume to attempt to make such an estimate of the future proceeds of an improvement which is about to be constructed, by applying the rule to every article which the line is expected to accommodate, with the best data we can procure, the result will be the nearest the truth of any which we can deduce, and, withal, not unworthy of confidence. But, if it were otherwise, the equation would still be susceptible of useful applications. It teaches that the revenue is

directly as the square of the charge for toll which could be levied without excluding the trade; and, consequently, if we put C' for this toll, and δ for any increase or diminution of the charge for freight—both being referred to the ton per mile—the charge for toll which the article will then bear will be

$$C' \pm \delta;$$

the positive sign being used when the freight is diminished, and the negative when it is increased.

Now, if R represent the revenue obtained before the increase or diminution of the price of freight, we shall have

$$R' = R\left(\frac{C' \pm \delta}{C'}\right)^2 \qquad \text{(L)}$$

for the revenue after the change shall have occurred.

We may apply this expression for the purpose of forming some estimate of the control which transporting companies have it in their power to exercise over the great lines of improvement of the country, which are maintained by the States, if they choose to form combinations for the regulation of the charges. If, for instance, the State of Pennsylvania, which is so situated, should find that a toll of three cents per ton per mile would exclude the whole of any article produced on the Ohio; and, after regulating the tariff in reference to that condition of things, should obtain from the commodity a revenue of one hundred thousand dollars; and the transporters should then think proper to increase the freight one cent per ton per mile, the Commonwealth would obtain a revenue of

$$R' = 100{,}000\left(\frac{3-1}{3}\right)^2,$$

or \$44,444. In consequence of an increase of freight of one cent per ton per mile, the revenue would, in this example, be reduced from \$100,000 down to \$44,444.

We could not, in the application of equation (K,) obtain all the data—as the value of t and β — with sufficient precision to predict with certainty a revenue of \$100,000, which we have supposed to be received; but after being taught by experiment the value of the revenue before the increase of the transporters charge, we can anticipate, with all desirable precision, the effect of that increase on the dividend. For this purpose we make use of equation (L) where those quantities of which the value is doubtful do not appear. In fact, it may be asserted as a rule, that whatever be the difficulty experienced in attempting to predict the amount of freight, or the revenue, which will be obtained by an improvement under known charges,—after experience has determined this point, we can always anticipate with great precision the revenue which will be received under any modification of the tariff. And this is all that is necessary to enable a company to operate with the greatest attainable advantage.

Errata.—In consequence of our not receiving the revised proof of Mr. Ellet's third article on the "Laws of Trade," until after the sheet was printed, several typographical errors escaped detection. Among them we

observe the word "investigate" for "integrate," "tare" for "charge," etc.—Eds. R. R. J.

For the American Railroad Journal and Mechanics' Magazine.

THEORY OF THE CRANK.

If Mr. Roebling will *re*-examine *carefully* the illustration given in the July No. of the Railroad Journal upon this subject, (pp. 36, 37, 38,) he will perceive probably that he has not given to that article sufficient attention.

Mr. R. will not, it is presumed, deny that the power acts with a certain leverage at *every point* in the quadrant. The *number* of the levers can, therefore, only be *truly* represented, geometrically, by the *arc of the quadrant*, AB or its *equal*, the line a b. (See the diagrams in the July number above referred to.) If from the several points in this line, perpendiculars or ordinates are erected equal in length to the *actual* leverage at the corresponding points in the curve, the whole will together form a surface, the *area* of which is the *sum* of *all the levers*. If this sum or area is divided by the number of levers, that is by ab, or AB, the quotient is evidently the *mean leverage*.

The mistake into which Mr. Roebling has fallen, consists in his taking the semidiameter AD to represent the number of levers instead of the arc of the quadrant AB.

Mr. R. will we trust see the propriety of withdrawing his accusation against the writer of the article referred to, of having "substituted a straight motion for a circular motion of the crank pin," and having represented "a circular motion as taking place in a straight line."

The straight line a b, to which he refers is made equal to the arc of the quadrant AB, and is so assumed for the purpose *solely* of illustrating the *geometrical* mode of arriving at the sum or number of all the levers. *No motion is assumed or "represented" as taking place along the line a b. That* line represents simply the space passed over by the crank pin, and is used in the demonstration for no other purpose but as a measure of that space or of the whole number of levers of which that space is the true and only exponent.

"Fulton."

For the American Railroad Journal and Mechanics' Magazine.

INTERNAL IMPROVEMENTS OF NEW YORK. PROPOSED PLAN FOR PROSECUTING THE RAILWAY SYSTEM IN THE STATE OF NEW YORK.

I. The State to subscribe for and own one-third of the capital stock in all railways hereafter to be constructed within the limits of the State; the subscription not to be made by the State until satisfactory evidence is produced of the subscription by responsible persons or any municipal corporation, of the remaining two thirds of the capital stock, and the organization of a company in due form, and on evidence also that the capital assumed is sufficient, or nearly so, for the construction of the proposed road. In the payment of instalments, a similar rule to be observed. The payments made by the State to be made subsequent to those made by individual

stockholders, and on evidence that the latter has been *actually expended* in the construction of the road.

II. The surveys for the *final location* of any railway to be made under the direction of the engineer of the company, in conjunction with a commissioner appointed by the State for the purpose, and no location to be definite until it has received the assent of a majority of the directors and been approved by the Chancellor or some one of the judicial tribunals of the State. *Preliminary* surveys of railroad routes may be made as heretofore by the State under *special* acts for that purpose, and where surveys have been made by and at the expense of individuals, prior to the formation of a company, and from which valuable information has been derived, the expense thereof to be refunded by the company.

III. The State to be at the expense of obtaining the right of way for all railroads, and the ground thus taken to remain the property of the State, the use of which is to be guaranteed to the railway corporation during the period of its existence. The negociations for obtaining the right of way to be made by the commissioner above named, and the appraisements for the same purpose to be made under his direction. The commissioner to receive a per diem allowance for his services, and his duties to cease when the award of the appraisers for the whole line of the road has been rendered. The appraisers to be composed of three competent and disinterested persons to be named by the Chancellor of the State, one of whom shall be the judge or supervisor or clerk of the county in wnich the lands to be appraised are situated, and of the remaining two, one shall be a practical farmer and the other a practical railroad engineer.

The appraisers to receive a per diem allowance for their services to be paid by the State.

IV. All railroads to be built with the view of transporting both passengers and freight; and in the construction and operation of any railroad the company to be subject to such regulations as the legislature may from time to time think proper by law to prescribe.

V. The mails to be conveyed upon all railroads at such rates or upon such terms as the companies owning the roads shall prescribe, or as any three disinterested persons appointed by the chancellor of the state shall deem to be fair and equitable. The railways together with the cars, engines and superintendents, and operatives connected therewith, to be at all times at the service of the General and and State governments, for the transport of troops, munitions of war, conveyance of expresses, &c. and in the event of a disagreement as to the compensation which any company is to receive, the same is to be left to the decision of three disinterested persons appoint- as above by the Chancellor of the State.

VI. The State not to receive any dividends on its portion of the capital stock in any railroad until the private stockholders get five per cent. and to receive all above that amount until the dividend on its portion amounts to three per cent. Whenever any dividend exceeds five per cent. on two-

thirds of the capital stock, and three per cent. on the remaining one-third, the surplus to be distributed equally upon all the stock.

VII. Railway companies already organized. whose roads are completed or in progress, which may wish to be embraced in the plan here proposed are to be particularly designated in the act passed for the purpose, and such as have received loans of the credit of the State, are to be entitled to have those loans converted into subscriptions to the capital stock and the interest already paid by them to be refunded.

VIII. The railway companies are to make semi-annual returns to the secretary of State of their expenditures and receipts, viz.: on the first days of November and May, of each year, to be accompanied with a general statement of their proceedings during the intermediate time. The returns and statements thus made to be approved by a commissioner appointed by the legislature, who is to have free access to all the books and accounts of every railway company. The commissioners to be two in number for the whole State, to receive a fixed salary for their services, and to make *alternate* examinations of the affairs of the several railroad companies in the State.

IX. The act for carrying into effect the plan here proposed, to authorise the formation of railroad companies, and to define the mode of accomplishing their organization, without resort to the legislature, and to specify in detail all those restrictions and privileges, suited to the circumstances of the case and which are applicable to railroad companies generally.

No railway to be constructed running parallel with, and within a distance of twenty miles of any other railway already constructed or in progress unless authorised by a *special* act of of the legislature.

REMARKS.

The period has arrived, or is very near at hand, when the people of New York must determine whether the railroad system is to be prosecuted in the same manner with the canal system, by means solely of the money and power of the State, or whether some other plan shall be adopted, better suited to accomplish the object in view and more consonant with the genius and character of our political institutions. That railways are much better calculated than canals to accomplish the important object of a cheap, expeditious and uninterrupted intercommunication between the different sections of the country at all seasons, has now become apparent. Although sustained thus far by private enterprise and means, the system is rapidly gaining the ascendancy, as is evident from the fact that within the last ten years, 475 miles of railway have been put in operation in the State, while during that period only 182 miles of canal have been constructed, and the proportion of miles of railway now in progress compared with canals is as nine to one in favor of the former. Indeed, so much have the latter gone into disfavor that the last which have been undertaken would not have survived the embryo state but for the genial warmth of the hot bed of politics in which the germs were placed.

The conviction is indeed very general that the canal system, pushed as it has been to an extreme, must, so far as it regards the construction of any new works, be abandoned, and the grave question arises, whether in the prosecution of the better improvement of railways, the arm of the State is necessary to its success.

The view we have taken of the subject has brought us to the conclusion that, whether right or wrong in the abstract, the aid of the State *will be invoked* and *successfully* in support of railways, and it becomes therefore an object of importance to ascertain the best and safest and most effective mode by which that aid can be rendered. It is for the purpose of contributing our mite to the enlightenment of the public mind, that the foregoing plan is presented, and unless such a plan, or one similar to it, is adopted, the State must continue the practice already partially introduced of aiding railway companies by a loan of its credit, or otherwise railroads, like canals must be madeState works.

To both of these methods there are objections of a very serious character, which, to our mind, are conclusive as to the impropriety of their adoption. We hold the principle to be a sound one, that individuals cannot with profit or advantage to themselves or to the community undertake the construction of railroads, if, in so doing, they are obliged to rely on borrowed capital. Instances may occur in which such a course may be pursued with safety to the stockholders, but we imagine there are few capitalists who would embark in an undertaking under those circumstances, and the plan can never become sufficiently general to effect the great object of a well arranged system of internal improvement. It cannot indeed be effected successfully unless the State becomes the creditor or endorser, and in this case it becomes doubly objectionable. If the interest upon the loans made is promptly paid, and the company fulfil all its obligations in *good faith*, then they are little better off than they would be if dependent entirely upon loans from individuals, while the system is liable to great abuses in its tending to corrupt legislation, and the too great facility it affords to the dishonest and influential among the larger speculators of the day, to pervert the funds of the State to the promotion of their own private and selfish purposes.

As to the other alternative of making railways State works the experience we have had in respect to canals should prove a warning to avoid, while yet we may, the great dangers and evils of such a system. Although but fifteen years have elapsed since the Erie canal was opened, yet in that short period the people of this State have witnessed enough of wasteful expenditure and of sacrifice made at the shrine of politics, to cause them to ponder long before venturing into the hidden depths of a new system which from its peculiar character is fraught with evils of fargreater magnitude than the old.

* The plan of aiding by a *bonus* is not considered as among the plans which can by any possibility be adopted.

In the construction and management of canals, the works being complete, all that is subsequently required of the State is to furnish the necessary agents for attending to the repairs and collecting the tolls. Not so with railways; they are a species of improvement so widely different from canals, as to render their indiscriminate use by the public impracticable, and they must either be leased out to individuals or to companies to share the fate of all lease-hold property, or otherwise maintained and operated by the State. The number of agents and operatives required in the latter case, the great vigilance and care necessary to insure a harmonious action of all the parts, and the great increase in the expense caused by an injudicious or unfaithful attention to its affairs on the part of its officers and agents growing out of the complicated mechanical character of the improvement, the evident impropriety not to say absurdity of making the government which was instituted for higher and nobler purposes the common carrier for the conveyance of marketable commodities, all indicate most forcibly the unsuitableness of such a system for accomplishing the object designed. Even in an adjoining State where this plan has been adopted only in part, the railways being built and maintained, and the motive power furnished by the State, it is found to be attended with an increased expense, and of course less advantageous to the public than if owned and managed wholly by companies placed under suitable restrictions, while all the evils which are inseparable from State works growing out of the increase of State patronage, the temptations to use the public treasury by the party in power and the promise of it by the party out, to purchase popularity, the injury produced in consequence to the public morals, and the great danger which it threatens to our free institutions, remain in their full force, and in all their appalling deformity.

In New York, in particular, where from the extravagant schemes into which the State has already entered, it is hardly possible, even if no new obligations are incurred, to pass through the next seven years without resort to taxation or new loans to pay interest, it would be the height of impolicy to swell the amount of indebtedness to the extent which would inevitably take place upon the adoption of the principle, since out of the 1500 miles of railway completed and in progress in the State, two thirds or 1000 miles would immediately be thrown upon the State, causing a sudden and enormous expansion of the State debt to 30 or 50 millions.

That there is a propriety in appropriating some portion of the public funds to promote the object of internal improvements we have no doubt, this arises from the fact that in the construction of every public work a very large portion of the community are materially benefited by the increased value given to their property, who make little or no use of the work, and contribute, of course, little to its support. There are also many individuals, perhaps one third, on the line of every improvement, who are among those most benefitted, but who doggedly refuse to aid their more liberal and patriotic neighbors, from the belief that the work will be constructed

without *their* aid, and in the spirit of a true piratical stamp, are willing to reap the benefit of their neighbors enterprise without rendering therefor any equivalent. It is for this reason and also for the great advantage which railways are to the community generally in the conveyance of the mails, in contributing to the general defence, of which they will be found to constitute the most efficient arm, from the facilities they afford for concentrating troops and munitions of war at particular points upon any emergency, and their salutary influence in the prevention of monopolies, that we concede the propriety of bestowing upon them in the most unexceptionable manner possible, the aid of the State to a limited extent.

This aid we conceive may be rendered in the manner above proposed, so as to be attended with more benefit and with less objections than any other, which has come to our notice. Under a *general law*, like the one proposed, all *special* legislation together with its attendant expenses and the pernicious consequences flowing from it in a moral and social point of view will be avoided. If, also, as in the plan proposed, individuals are required to contribute two thirds, of the capital needed, the State will not be as likely to be drawn into the construction of unprofitable or useless works. The propriety, not to say necessity, of adopting some plan for checking prodigal expenditure in this respect, must be apparent to any one conversant with the history of legislation in the several States where works of internal improvement have been constructed at public expense. It will, indeed, be impossible, under this plan, to appropriate the public funds as has heretofore been done in two many instances, to works devoid of merit, while at the same time, the system of internal improvements will advance with sufficient rapidity, and the best security be afforded of its being preserved in a sound and healthy state.

As it respects the location of railways the provisions contained in the plan appear to us to be particularly appropriate, for experience has shown that the duty of making a location cannot always be safely intrusted *exclusively* to a majority of a board of directors, many of whom perhaps have local interests to subserve which are adverse to those of the public and a large proportion of the stockholders. Experience has also shown the propriety of the method proposed in Sec. 3rd, for obtaining the *right* of *way*. In all railway charters thus far granted in New York, the provisions for this purpose are exceedingly onerous upon the companies, the benefits to the land proprietors not being allowed to be taken into consideration in the assessments for damages. Great expense has consequently been necessarily incurred in obtaining the right of way, amounting in some cases to $3,000 or $4,000 per mile, and in one instance to $7000 per mile, and in nearly every case the benefits accruing to the land intersected by the road were equal in the aggregate to the damage produced added to the value of the land taken. To obviate this great expense to which companies are unjustly subjected, the plan proposes that the ground should be taken and owned by the State. This course is also recommended for another reason. It puts at

rest the question of the right of the legislature to authorise the taking the property of individuals for the use of incorporated companies. A question, which so far as we have been informed has never been *definitely* settled, and in respect to which there exists doubts in the minds of those most skilled in expounding the constitution and laws of the State.

The advantages already described as accruing to the community generally from the construction of railroads, constitute a sufficient reason for devolving upon the State the expense of obtaining the right of way which from the mode of making appraisements, as hitherto pursued upon the State works, will not be heavy, while it will relieve the railway companies from a very great burthen. The same reason is also considered sufficient for withholding, as in Sec. 6, dividends upon the portion of stock held by the State, until the private stockholders realize five per cent.. This amount is considered sufficiently large to afford all necessary encouragement to individuals to become subscribers to the stock, while at the same time it is not so large as to constitute a satisfactory return to the stockholders for their capital invested, and induce them from any improper motives, by swelling the expenses, to keep down the surplus so as to exclude the State from a reasonable participation in the profits of the work.

There are other features of the plan, the propriety of which will, we think be obvious and will not therefore need to be particularly illustrated. Improvements may undoubtedly be made in the details, but in the general outline, it is believed to be the only mode in which the railway system can be placed upon a sound basis so as to produce the greatest good with the least expense and with the least evil resulting.

In adopting this plan the indebtedness of the State will not of necessity be greatly increased. Of the several railways in progress the two leading ones are the New York and Erie, and New York and Albany. To these may be added the Ogdensburg and Champlain which will probably soon be commenced. The cost of the first will not fall short of nine millions of of dollars. The credit of the State is already pledged to its support to the amount of one third of that sum or three millions.

The interest which has been paid on the part of this sum which has already come in possession of the company will need to be refunded or deducted from the succeeding payments, and the loan converted into a subscription to the stock which will aid very materially the efforts of that company without increasing the indebtedness of the State.

The amount required for the New York and Albany road will be about one million, and for the Northern road $700,000. There are some roads of lesser magnitude, such as the Saratoga and Whitehall, Syracuse and Oswego, Batavia and Buffalo, etc. which may require a million more. An increase of State debt then of only three millions of dollars, will be sufficient therefore to place the several works upon a stable and prosperous footing, and by extending the system to other works to which loans of the credit of the State have already been made, viz.: the Ithaca and Owego, Catskill and

Canajoharie, Auburn and Syracuse, Auburn and Rochester, Hudson and Berkshire and Long Island, converting these loans into subscriptions to the stock and repaying the interest, essential aid will be afforded to these important roads without materially increasing the State debt which will relieve them from present embarrassment, and place them in a condition of greater usefulness to the public.

The State of New York has thus far been content to exert its energies and expend its resources upon canals. The limit of prudence in its expenditures upon these has for some time been exceeded, and the system, cancer-like, is advancing at no very moderate rate towards the more vital parts, and if not soon arrested may prove to the tax-paying portion of our citizens a curse instead of a blessing. Fortunately the railway system has attained a degree of perfection which will cause it to supercede the necessity for any more canals, and as no bad precedents have as yet been established, railways, having as yet in no instance been made State works, and as the opportunity is a favorable one for the State to extricate itself from a very dangerous position, and escape from the gulf in which it was about being plunged by its departure from sound principles, we hope those principles will be permitted to prevail, and that the experience of the past will prove a sufficient warning to future legislators not to involve the State in a system of internal improvements, having an inevitable tendency to impoverish the public treasury, and which is destructive to the morals of the people, and fraught with imminent dangers to our free institutions.

FULTON.

RAILROADS IN THE UITED STATES. By Chevalier De Gerstner.

(Cotinued from page 344.)

RAILROADS IN OHIO, INDIANA, MICHIGAN AND ILLINOIS.

Ohio has early embarked in a system of internal improvements; but following the example of the State of New York, has chosen canals to form the artificial lines of internal communication through this large State. Several railroads were long afterwards undertaken by private companies whom the State assists by guaranteeing loans to the amount of one-third the cost of the works. Passing through a flat country, and intended to accommodate only a small traffic, the railroads in Ohio are constructed on a cheap plan, but are nevertheless progressing very slowly, owing to the difficulty of providing the necessary funds. For the Ohio Railroad, which is to extended along the shore of Lake Erie, a width of track of seven feet has been adopted—the other railroads have the usual width of four feet eight and a half inches.

In *Indiana* the internal improvements are, like the canals in Ohio, undertaken at the expense of the State, and consist in a system of canals, turnpike roads, and one railroad, leading from the capitol of the State to the Ohio river. This railroad is constructed in a very permanent manner. Another along the northern boundary line of the State has been commenced by a company, but the works were afterwards suspended for want of capital.

Michigan, though one of the youngest States, will soon have all the settled parts of the country traversed by railroads, which are partly construct-

RAILROADS COMPLETED AND IN PROGRESS IN THE STATES OF OHIO, INDIANA, MICHIGAN, AND ILLINOIS.

No.	Name of railroad.	From and to where.	Opened. Year.	Opened. Miles.	No. of Miles. Besides graded.	No. of Miles. Not yet const r'd.	Total length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion.	Total cost of road.	Cost per mile.
1	Mad River & Lake Erie,	Sandusky City to Springfield.	1838	15	30	85	130	plates $2\frac{1}{4} \times \frac{5}{8}$	1 locomot.	155,000	755,000	910,000	7,000
2	Little Miami,	Cincinnati to Springfield.			20	65	85	$2\frac{1}{2} \times \frac{3}{4}$		100,000	900,000	1,000,000	11,765
3	Monroeville & Sandusky	Monroeville to Sandusky City.	1838	15			15	$2\frac{1}{4} \times \frac{5}{8}$	horses	75,000	15,000	90,000	6,000
4	Cleveland and Newburg City.	Cleveland to Stone Quarries.	1838	6			6	wooden ribbon.	horses	18,140		18,140	3,023
5	Fairport and Painsville,	Fairport to Painsville.	1838	3			3		horses	22,000		22,000	7,333
6	Ohio,	Coneaut to Maumee Bay.			30	147	177	$2\frac{1}{2} \times \frac{3}{4}$		50,000	1,189,000	1,239,000	7,000
1	Madison & Indianapolis,	Madison to Indianapolis.	1839	20	30	40	90	rails 45 lbs.	2 locomot's	1,300,000	2,200,000	3,500,000	38,889
2	Buffalo & Mississippi,	Western to Eastern Boundary of the State.			10	146	156			75,000	1,225,000	1,300,000	8,333
1	Erie and Kalamazoo,*	Toledo to Adrian.	1836	33			33	plates $2\frac{1}{4} \times \frac{5}{8}$	2 "	281,000	19,000	300,000	9,091
2	Palmyra & Jacksonsburg	Palmyra to Jacksonburg.	1838	11	5	30	46	$2 \times \frac{1}{4}\frac{5}{8}$	horses	53,000	246,000	299,000	6,500
3	River Raisin and Lake Erie,	Monroe to Lake Erie.	1838	4			4	wooden ribbon.	horses	44,000		44,000	11,000
4	Detroit and Pontiac.	Detroit to Pontiac.	1839	18	7		25	$2\frac{1}{4} \times \frac{5}{8}$	1 locomot.	160,000	40,000	200,000	8,000
5	Shelby and Detroit,	Detroit to Utica.	1839	10		7	17	wooden ribbon.	horses	23,000	17,000	40,000	2,353
6	Ypsilanti & Tecumseh,	Ypsilanti to Tecumseh.			5	19	24			40,000	160,000	200,000	8,333
7	Detroit and Maumee.	Manhatten to Havre.			3		3			15,000	5,000	20,000	6,667
8	Central,†	Detroit to St. Joseph.	1839	38	30	128	196	$2\frac{1}{4} \times \frac{5}{8}$	5 locomot's	800,000	1,552,000	2,352,000	12,000
9	Southern,†	Monroe to New Buffalo.			50	139	189	$2\frac{1}{4} \times \frac{5}{8}$		420,000	1,659,000	2,079,000	11,000
10	Northern,†	Point Huron to Grand Haven.			10	$191\frac{1}{3}$	$101\frac{1}{3}$	$2\frac{1}{3} \times \frac{5}{8}$		60,000	1,955,000	2,015,000	10,000

* 12 miles of this railroad are in the State of Ohio. † These 3 railroads are State works.

RAILROADS IN OHIO, INDIANA, MICHIGAN, AND ILLINOIS.—Continued.

No.	Name of Railroad.	From and to where	Opened. Year.	Opened. Miles.	No. of miles. Besides graded.	No. of miles. Not yet constr'd.	Total length of road.	Weight or dimensions iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion	Total cost of road.	Cost per mile.
1	Central,	Cairo to Galena.			85	65	450	$2\frac{1}{4} \times \frac{3}{4}$		400,00			
2	Northern Cross,	Quincy to State line of Ind'a.	1839	16	100	114	230	"		785,00			
3	Peoria and Warsaw,	Peoria to Warsaw.			24	92	116	"	2 locomot's	140,00			
4	Bloomington and Mackinaw,	Pekin to Bloomington.			10	$26\frac{1}{2}$	$36\frac{1}{2}$	"		75,00			
5	Southern Cross,	Alton to Mount Carmel.			30	117	147	"		150,000	14,007,500	15,768,000	12,000
6	Alton & Shawneetown,	South Cross to Shawneetown.			15	130	145	"		75,000			
7	Alton and Shelbyville.	Alton to Shelbyville			15	93	108	"		45,000			
8	Central Branch,	Shelbyv'le to State line of Ind.			20	$51\frac{1}{2}$	$71\frac{1}{2}$	"		90,00			
9	Rushville and Erie,	Rushville to Erie.				10	10	"		500			
10	New Pittsburg &Miss.*	Illinois Town to Coal Mines.	1838	7			7	$2 \times \frac{1}{2}$	horses	42,000		42 000	60 00
11	Galena and Chicago Union,*	Galena to Central Railroad.			4	96	100			30 000	1,170,000	1,200,000	12,000
29				196	533	$2092\frac{1}{2}$	$2821\frac{1}{2}$		13 locomot's	23,64	27,114,5	32 638,1	11,568

* These two railroads are constructed by companies; all the others are State works.

The following table gives a summary statement of the works in each of the four Western States.

Name of State.	No. of railroads.	No. miles in operation.	Total length of road	No. of locomotives.	Am't of capital expended.	Am't necessary for completion.	Total cost of railroads.	Average cost per mile.
Ohio,	6	39	416 miles.	1	$ 420,140	$2,859,000	$3,279,140	$ 7,883
Indiana,	2	20	246 "	2	1,375,000	3,425,000	4,800,000	19,512
Michigan,	10	114	$738\frac{1}{2}$ "	8	1,896,000	5,653,000	7,549,000	10,222
Illinois,	11	23	1421 "	2	1,832,500	15,177,500	17,010,000	11,970
	29	196	$8221\frac{1}{2}$ miles	13	$5,523,640	$27,114,500	$32 638,140	$11 : 68

ed by the State, and partly by private companies. The country is very favorable for the location of railroads, and they are therefore executed at a very moderate cost.

The system of railroads projected in *Illinois* is far too great for the present population, trade, and resources of this young State, and it will be long before all the railroads projected and under construction will be completed. Besides the State works, only two railroads have been undertaken by private companies, one of which has been completed; of the other, the works are suspended. The width of track of the railroads both in Michigan and Illinois, is four feet eight and a half inches.

The data for the following statement has been collected during the months of August and September, 1839, and as very little has been done from that time to the end of the year, the numbers have been left unaltered.

Of the 29 railroads in the States of Ohio, Indiana, Michigan, and Illinois, only 196 miles have been completed and put into operation; of these, 56 miles are used with horse power, and 140 miles with locomotive engines; each locomotive serves, therefore, for 11 miles of railroad. When all the railroads projected and commenced in the above four States will be completed, their aggregate length will be 2,821½ miles.

The total amount already expended on all the 29 railroads is $5,523,640, and near five times as much, or $27,114.500, will be required, according to the estimates, to complete the works; the total cost being estimated at $32,638,140, or only at $11,568 per mile at an average. This cost appears very low, compared with that of other railroads; but with the experience already acquired in the construction of these kind of works, and where the country offers so few obstacles to their location, there is no doubt that railroads with wooden superstructure and plate rails may be executed for the sum of $12,000 per mile.

☞ We have received a communication from Mr. Wm. Mc C. Cushman, which will appear in our next number, it having been received too late far this one.

The Canal.—It affords us pleasure to be able to state that the work on the canal is now going on with much spirit—numerous hands are employed at the earth-work and the protection wall in front of the bluffs near this town; and we have the fullest confidence that the first mile, including the dam eighteen feet in height, across the Milwaukie river, will be completed within the next year. This will afford us an immense water power in the town, which will induce the building of large flouring mills, so much needed by the farmers, as affording a ready market for their produce, even the present season.—*Milwaukie Adv.*

ON SAFETY VALVES AND SAFETY PIPES.

Formerly, when a *condensing* engine was spoken of, it was always considered that a *low pressure* engine, either Newcomen's or Boulton and Watt's, and working at only two or three pounds above the pressure of the atmosphere, was the kind of engine meant. But of late years, since the Cornish fashion of first expanding and then condensing high pressure steam has come into use, the terms used are no longer convertible.

More recently, owing to the great improvements made in engineering tools and workmanship, Trevithick's high pressure non-condensing engine has been made in such perfection, that it is frequently capable of working well at a *lower* pressure than even the Boulton and Watt low pressure

engine is sometimes working at in the factory districts. Consequently there is some fear of a confusion of terms in those various designations, not perhaps when applied to the engines themselves, but with respect to their boilers. Thus, for instance, we sometimes see accounts in the newspapers of high-pressure boilers being *blown up* or exploded ; and of the low-pressure boilers of condensing or factory engines only *bursting*, while the later may really have been working at a higher pressure than the former.

There are, however, one or two broad marks of distinction between the two classes of boilers, well known to all practical engineers, and terms expressive of those distinctions (*high* and *low* pressure) have grown into use from the original manner of working the two great classes of engines, Boulton and Watt's, and Trevithick's. These terms, we think ought to be adhered to, not only because they sufficiently indicate, to the public generally, the presence or absence of great danger, and correctly so when properly used, but also because it is probable that that portion of the working mechanics of this country usually entrusted with the care of steam engines will continue to adhere to what has been sanctioned by long usage.

High-pressure boilers are universally known in England to be generally circular or cylindrical, or some form closely approaching thereto, and with hemispherical ends, (technically called *egg* ends,) unless the boiler contains an inside flue, and then the ends are only segmental or slightly convex,—but in all cases made without sharp corners or acute angles, and with iron plate of sufficient thickness not to require any internal stays to strengthen it.

Low-pressure boilers are not limited to any particular form, but so contrived as to suit the place they have to stand in, or that form which is most convenient for applying the fire to the most considerable portion of their surface. And the more they differ from the circular or cylindrical form, the more they require internal stays to support them, not only against the internal pressure of the steam, but also against the external pressure of the atmosphere, in case the steam should at any time happen to fall below that pressure.

To provide against the partial vacuum which produces the last mentioned effect, low-pressure boilers are also usually supplied with an air valve, sometimes called an *internal safety valve.* It is a small valve opening inwards, and weighted with only a few ounces, so that should the steam fall ever so little below the external pressure, it opens and allows air to pass into the boiler.

On the contrary, the high-pressure boiler is supplied with an *external* safety-valve, weighted so as to blow off at a little above the pressure that the engine is calculated to work at, which should never be more than one-third of that which the boiler has deen proved to be able to sustain.

There ought, indeed, to be two safety valves, one locked up, loaded with the proper weight, and without the intervention of a lever ; the other under the engineer's control, with a lever and spring balance indicating upon a scale the pressure exerted upon the valve to confine the steam.

The great and leading distinction, however, as respects danger, between the high and low pressure boiler, is, that usually the former requires to be supplied with water by a force pump worked by the engine, and which injects a small quantity at every stroke against the elastic force of the steam ; while on the other hand, the low pressure boiler is supplied by means of a *feed pipe* standing on the top of the boiler, and containing a column of water of sufficient weight to balance the pressure of the steam, the water in the boiler being constantly supplied so as to retain the proper altitude, from a small open-topped cistern on the top of the pipe, which cistern is kep

supplied either from the hot well by the engine or from any other source.

Now, as the feed-pipe of a low-pressure boiler is only required to be of sufficient length to hold such a head of water as will, by its hydrostatic weight or pressure, balance the greatest elastic force of the steam intended to work the engine, it is evident that as soon as this limit is exceeded, the water in the feed pipe will be liable to boil or prime over, and, consequently, under such circumstances, the boiler becomes as perfectly safe as any ordinary open-topped pan of the same height as the top of the feed cistern.

From the above description we see the inutility of a safety valve on a low pressure boiler, except for the purpose of blowing off the steam occasionally, and thereby preventing the inconvenience resulting from boiling over; and this is accomplished generally by means of a valve placed on the steam pipe leading from the boiler to the engine, so as to be at hand for the engineer to blow off when required, previous to stopping the engine.

Many people we know strongly recommend a safety valve to be placed on the boiler itself in addition to the ordinary blow valve of a low pressure boiler, but in the case of a boiler fitted up in the manner we have described, any one may perceive it would be perfectly useless, *and therefore, practically injurious.* In saying this, it is not of course, to be understood that any harm can accrue from an extra safety valve abstractedly considered, but only as it is a means of withdrawing attention from other more obvious means of safety. In this view of the subject the safety valve may be aptly compared to Sir Humphrey Davy's celebrated safety lamp for coal mines, of which it is frequently said, and we think truly, that for every life it has saved it has been the means of destroying twenty, by inducing a negligent attendance to improved systems of ventillation.

The common feed pipe of a boiler is, in fact, a *safety pipe*, and very much superior in all respects to any safety *valve* that can possibly be devised, the moveable column of water within the pipe answering the purpose of both valve and weight; and it is justly considered as a beautiful example of the general superiority and simplicity of using hydraulic means in accomplishing objects of this kind, over the ordinary mechanical contrivances. In the most improved arrangement for this purpose, (we allude to Mr. Elsworth's hydraulic joint for superceding the stuffing box of the buoy-rod,) if considered as a safety valve, there is this essential property, *it cannot be overloaded* or tampered with in any respect; besides, it is impossible for it to *stick* or get out of order, because it is continually on the move, and that without wasting any steam.

Until within the last two years there were probably 400 to 500 boilers working in Manchester without safety valves, but nine out of ten of them, at least, were fitted up with the common feed pipe as above described; yet the proportion of fatal accidents from explosions of boilers in Manchester are almost as nothing in comparison to the number that occur in steam boats, although, in the latter, the boilers are always supplied with at least one safety valve.

The fact is, that, both in high and low pressure, the chance of an explosion occurring is more dependent upon the mode in which the boiler is supplied with water than upon any thing else, and although the common feed pipe is not so applicable in steam boats as on land, yet a safety pipe acting on the same principle might be very easily applied, and would serve as an infallible check against the water getting too low as well as against the steam getting too high, if made with its lower end to terminate a little above the flues, so as to allow the steam to blow away whenever the surface of the water in the boiler descended below that point.

A patent safety pipe has, we understand, been tried in London, but it is

so contrived as to *put out the fire*, by boiling over into it, whenever the steam gets too high, which property would be perhaps in many cases an inconvenient addition, although not half so bad as an American safety pipe which has very recently been puffed through all the newspapers, and which is described as having the following curious property: *when the steam is too high it shuts the furnace door quite close, so as to make it impossible for the fireman to open it* to supply more fuel. Now if this patent contrivance had been made to act quite the reverse, or to have *opened* the furnace door as we do in England, instead of *shutting* it, the invention might have been useful; but as it is, it is much more calculated to cause explosions than to prevent them.

ON THE STEAM ENGINE.

(Cotinued from page 278.)

In a previous paper we quoted Mr. Palmer as stating the maximum effect that nature is capable of accomplishing to be 44,467,500 lbs. raised one foot high, with one bushel of best Newcastle coals, in the absence of all *friction*. And at the same time we stated that a Cornish pumping engine, in London, had performed a duty of 72,000,000 lbs. besides the accompanying *friction*. According to a later report, the same engine has performed 92,000,000 lbs. duty, besides friction—Welsh coals having been used, and the steam cut off at $\frac{1}{3}$ of the stroke; which latter circumstance we wish particularly noticed, as corresponding with our experience, and because we shall have to allude to it hereafter. It here appears that the *duty actually performed* by steam is more than double the utmost power that steam possesses, as Mr. Palmer understands and states it. How great then his error becomes, when the *friction* is added to the duty, which in the Cornish engines is frequently much more than the duty itself; and how clearly it appears that he did not know one quarter part so much of the true value of steam as the Cornish engineers whom he so presumptuously undertook to rebuke.

The friction of the Cornish single pumping engine has been treated by Mr. Wickstead as single also; now, although the action of steam, from its being confined to one stroke in these engines, is single, yet the friction extending alike to both strokes of the engine and the pumping machinery also, is double, and the joint amount truly enormous, from the great mass of matter to be moved, of which the timber pump-rods alone, 12 to 14 inches square, extend perpendicularly 700 to 800 feet or more, and in many instances to great distances horizontally. In none of the reports of duty by the Cornish engines are these important contingencies either described or alluded to with the attention they deserve or that is required for a due considertion of the subject, but are all indiscriminately merged into the comprehensive term "friction;" and this being doubled by the peculiar formation of the engine, is necessarily prodigious as it appears to be in Mr. Henwood's tables, in 2d vol. Journal Inst. Civil Engineers. Hence, the reported "duty" of these engines has been only the inadequate representative of a portion of their *power;* for it must be readily conceded that all power wasted or misapplied is as truly power as that usefully employed; and this latter portion alone has the duty hitherto truly represented.

The annexed table is abstracted from Mr. Henwood's lucid and valuable description of his careful experiments on the best engines in Cornwall. It will be seen that Watt's double condensing engine, an estimate by Professor Renwick of the loss of power of which we condemned in a formar paper as extravagant, and justly condemned as we shall hereafter prove, becomes by contrast with these in the table the very mirror of economy.

ABSTRACT FROM HENWOOD'S TABLES.

EAST-CRENNIS. Cyl. & steam pipes cov. with sawdust	BINNER DOWNS. Cyl. & steam pipes heated with fire.	HUEL-TOWAN. Cyl. bottom and cover steam cased		ENGINES.	
76	70	80	in.	Diameter of Cylinder.	
10	9	8	in.	Steam.	Diam. of Valves.
14	12	12	in.	Equilibrium.	Diam. of Valves.
16	[illegible]	16	in.	Exhausting.	Diam. of Valves.
10.25	10.00	10.00	ft.	Cylinder.	Length of Stroke.
7.16	7.50	8.00	ft.	Pump.	Length of Stroke.
26 two of	33	36	in.	Diameter.	Air Pump.
4.5	4	4.0	ft.	Stroke.	Air Pump.
1920	636	1080	cub. ft.	Water in Boiler.	
650	350	700	cub. ft.	Steam in Boiler.	
88.2	89.2	93.8	deg.	Temperature of Hot Well.	
67.0	52.3	64.7	deg.	Temp. Condensing Water.	
37.5	48.0	72.0	sq. ft.	Area of Fire Grates.	
57	76	114	sq. ft.	Surface exposed to action of Flame.	
2500	1440	2600	sq. ft.	Total heating Surface exposed.	
36.8 / 26.3	74.78 / 58.0	61.8	lbs.	Absolute Steam Pressure in Boilers per sq. inch.	
1/3 / 2/3	1/6 / 1/7	6/13		Times Steam is expanded.	
25 / 21	26 / 25	27	lbs.	Absol. steam in cyl. per sq. in.	
11.4 / 11.4	10.23 / 10.2	10.2	lbs.	Load per inch on area of Piston—Useful Effect.	
13.6 / 9.6	15.7 / 14.8	16.8	lbs.	Friction—Loss of Power—Useless effect.	
22½	25	24½	hrs.	Duration of Experiment.	
3005 lbs.	[illegible]	Bu 50= [illegible]		Coals consumed.	
1	1	1	Pts.	Oil used.	
17	15½	20	lbs.	Grease used.	
[illegible]	11,258	7,881		No. strokes made by engine.	
3.5	7.49	5.35		Strokes per minute.	
1.7	1.34	1.6	sec.	Duration of working stroke.	
4.17	4.23	4.8	sec.	Duration of return stroke.	
11.2	2.4	1.8	sec.	Interval between strokes.	
870	1006	1085		Tons lifted 1 foot for 1 farth.	
73,502,69	74,395,[illegible]23	77,533,107		Duty in lbs. lifted 1 foot with 84 lbs. dry coal.	

The tables from which the preceding is compiled contain very careful descriptions of important *facts*, to which we have added a column with the nearest vulgar fraction, denoting the quantity of steam expanded, and another column for the "friction," or power wasted or uselessly expended, to show at a glance, without trouble, the actual advantages or disadvantages of using steam of various densities.

Let us now compare these *facts* with a table and statements from Prof. Renwick's Treatise, p. 157.

"*Relative powers of an engine using the same quantity of fuel, and acting expansively at different tensions.*

Force in atmospheres.	In lbs	Cylinder filled.	Effective force
$1\frac{1}{6}$	17.5	wholly.	10.00
2	30.0	$\frac{1}{2}$	10.75
3	45.0	$\frac{1}{3}$	27.50
4	60.0	$\frac{1}{4}$	35.60
5	75.0	$\frac{1}{5}$	43.50
6	90.0	$\frac{1}{6}$	51.00

It will therefore appear, without any change in the general distribution and plan of an engine, provided the boiler be strong enough to bear the increased force of the steam, its power may be readily increased five-fold.

Again (p. 158;) "This method has been brought to the test of actual experiment, in the pumping engines in the mines in Cornwall, and by its use the power of an engine of a certain nominal horse power has been increased five-fold."

Again (p. 160;) "In this way the force of steam has been gradually raised from little more than a single atmosphere to ten; and an intelligent Cornish engineer states he has seen it raised to 20 or 30 atmospheres."

Now it is most desirable and essential that this bold theoretic statement should be examined by competent persons, whose examination might confirm it if right, or disprove it if wrong, for the sake of the public weal—for the many individuals interested in such a multitude of respects—and for the national character, which cannot fail ultimately to be seriously affected by the currency of such opinions, and by the dangerous practice recommended from such an illustrious source.

Now if Professor Renwick is right, if this his statement is true, it is as evident as the sun at noonday, that the power of an engine using the same fuel and expanding the steam, may not only be readily increased five fold, but ten fold or more; because this plausible theory is altogether based and depends upon an unlimited gain being attainable from a limited cause—stripped of its learned disguise, it would be as unfounded, as were the opinions of those unfortunates seeking perpetual motion.

To prove the unsoundness of these views, as we may, and desire to do, without discussion, we have only to bring the theoretic statements into juxtaposition with Mr. Henwood's experiments, which in density of steam, and in times expanded, though all purely accidental coincidences, are as impartial and correct trials of the theory as could have been contrived by man.

Thus, then, the duty of the Binner-Down engine using steam of 75 lbs. elasticity, should have been 300 millions, or more than four times as great as the duty (73 millions) of the East-Crennis engine, using steam of 26lbs. elasticity. But the difference in the duty of these two engines, tried so carefully under circumstances all corresponding with the theoretic statement—with steam exactly corresponding with those prescribed, from which such great advantages are unhesitatingly promised—this difference of duty

instead of being as stated, 3 times the duty of the East-Crennis engine, appears less than the $\frac{1}{75}$ part thereof; and even this almost insensible quantity is probably the result of mere accident.

Hence, then, it has been satisfactorily and experimentally proved that steam of 75 lbs. per inch expanded, is of no greater value whatever than steam of 26 lbs. per inch used expansively; we are thus allowed the choice of only two opinions—either the learned theorist or the unlearned steam-engine must have been mistaken; and, hard though as it may be, we have no doubt this uncandid world will be far more ready to attribute the mistake to the former than to the latter, which from natural dulness and incapacity, will probably be pitied rather than blamed. But the theorist may even then amply console himself by reflecting, how difficult it is to find an engineer who is not just as much mistaken as himself on this particular subject, for the very construction of these Cornish engines, and their using steam of such different densities, evidently prove a seeking for some as yet undiscoverable advantage. If he wants farther consolation, let him observe the uncertainty that prevails in the construction of engines, scarcely any two being built alike—or the more brilliant example afforded by the splendid public experiments in which the United States government indulges, who from mere inability to discover the wonderful advantages anticipated in that most exquisite of all steamers, the Fulton, are building two more on different principles and at a venture, determining if possible to discover the hidden perfections of the first. Now we have shown in this paper that one of these second thoughts, the British marine engines is a poor affair to copy—in our next we will show the other is worse.

If he does not then receive full consolation, let him observe how readily and constantly in all countries is a plausible and lazy, if brilliant, fiction preferred to sober facts demanding study and serious attention. Were facts substituted for fiction in this matter, however trivial they may appear to a superficial and careless observer, it would soon be seen that on the proper application and appreciation of them such an immediate great and general improvement of the steam-engine would ensue, as in its various and total results can hardly be overstated by the most sanguine admirer of that mighty instrument of civilization.

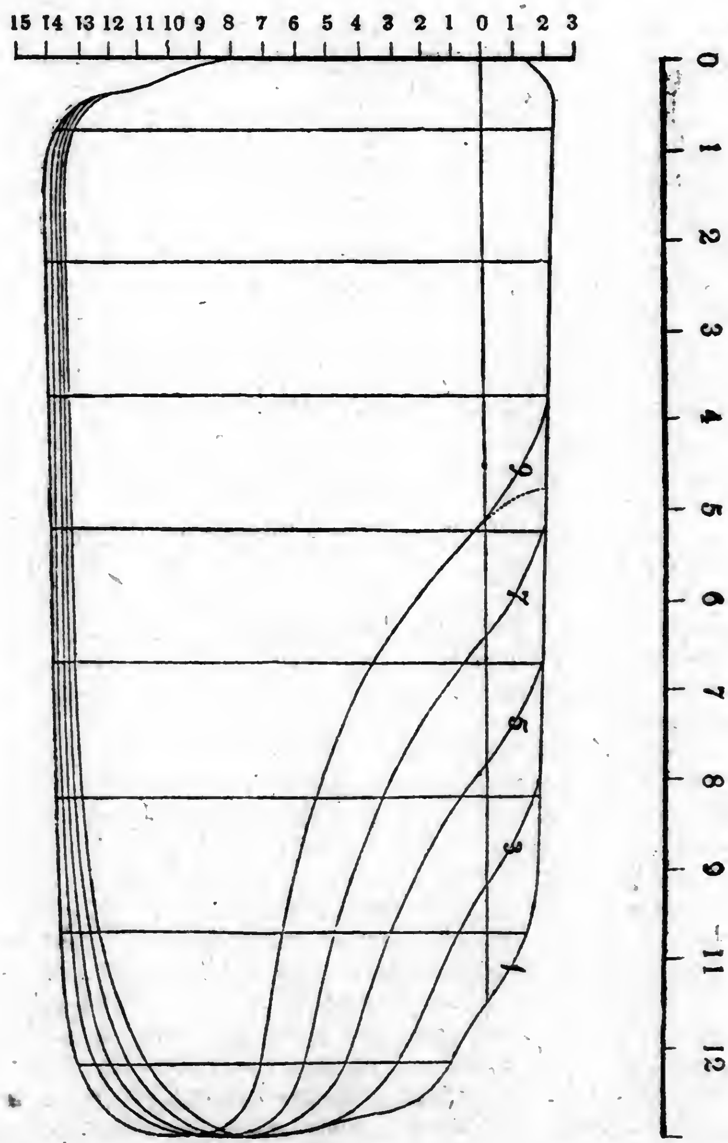
It is in continual shadow hunting that substantial truth is overlooked, and great and real advantages are disregarded; would engineers but condescend to examine and appreciate the true nature of expansive steam; would they but condescend to be satisfied with the great and real advantages it possesses—would engineers, (we ask not philosophers) condescend to disburthen or to cease from burthening expansive steam with useless conditions and pernicious and visionary restrictions, destructive of its usefulness, immense improvement would immediately ensue, and soon become general in the steam engine, which luckily never yet became a theorist, and therefore will ever and constantly be found obedient to reason.

Now we have shown, page 162 of this essay, that it is commonly a matter of great, if not perfect indifference, if from a given volume of water and heat whether high steam or low steam is formed and employed to produce motive power.

We have also shown, page 164, the value of gain from steam expanded is ever definite, and proportional to the density of the steam before its expansion. From these two positions it necessarily results, that whether proportional quantities of high or low steam be expanded to produce motive power, the superior quantity of the weaker expanded steam acting on a larger suface, will always compensate for the superior density, but lesser quantity of the denser steam acting on a lesser area; and these two distinct

actions of high and low expansive steam will be precisely equal, leaving for future consideration some disturbing forces not now pressing for immediate discussion, and which can be more satisfactorily treated hereafter. These equal actions, though so contrary to the current and popular opinions universally prevailing, are positive facts, necessarily arising from the definite nature of steam definitely expanded within a heated cylinder, and these its certain and invariable qualities are proved to the very letter, and as perfectly as the sagacity of man can devise, by Mr. Henwood's experiments on the Binner-Down and the East-Crennis engines; and just as plainly, fully, and satisfactorily are Professor Renwick's theoretical statements contradicted.

We shall attempt to establish an important and invaluable truth on the destruction of this extensive and dangerous error by which the utility of the steam engine has been much lessened, and happily we shall be just as able to produce undeniable facts in proof as we have already done for all our assertions; so that in every thing we are about to adduce, we shall be supported by indisputable evidence.



For this purpose we annex a fac simile of a diagram described by an indicator attached to one of the engines of the Great Western steam ship, and like the "handwriting on the wall," it greatly excels the handwriting of man. It gives a clear insight and full detail of the true internal state and power of the engine under varied circumstances, its capacity for improvement and even the acquirements of the manufacturing engineer—matters essential to be known and difficult to be otherwise determined. The diagram shows the steam as cut of by cams, (9) five of which are numbered and their effect ascertained, besides that of the slide movement. This engine is undeniably experimental, and the production of a mind seeking and not possessing information of the most essential character conceivable in a marine steam engine.

8)120.45

15.05
1.05 deduct for friction.

14.05 effective pressure per square inch.

On the proper application of steam evidently depend the form, dimensions, and weight of boilers, water, space and weight of machinery, the quantity and cost of fuel and labor, and the portion of freight usefully employed for those purposes. In fine, the speed, expense, and profit of steam navigation evidently as much depend on the proper application of steam, as this again must ever depend on a knowledge of its useful and definite properties. All these are vital matters in steam navigation on the ocean, and are in those engines much miscalculated, and evidently not yet understood.

The journal of the British Queen steam ship, page 50, vol. i. of this work, will show how far behind the age are these British marine engines; in a voyage occupying 450 hours the steam was expanded during 388 hours, at what is termed in this journal two-eigth stroke, but which from diagram now before us of that engine was three-sixteenth parts only, the remaining 62 hours mostly three-eighth parts of stroke, and of which only 18 hours extend to five-eighth stroke; and we have the fullest assurance the steam in the Great Western was no better employed, as the engines in that vessel are equally insufficient for a better application of steam.

The full and uninterrupted use of expansive steam, with its various advantages being impracticable in these vessels from the disproportion of their engines, is from necessity confined to the paltry purpose of saving an inconsiderable quantity of fuel in unfavorable weather alone. How effectually and profitably may these engines be improved, or how certainly and easily be surpassed.

Thus, then, may another shining light, another learned theorist be farther instructed by the mechanics he so ignorantly attempted to mislead when he so profoundly and learnedly proved the impossibility of navigating the Atlantic by steam; which we, mechanics only as we are, mere dust, are about to prove, has as yet, though so surprising to the intellectual doctor, been but tardily and imperfectly accomplished. A consideration of this diagram will render evident another and considerable advantage in the application of expansive steam, unnoticed by the visionary, unexpected by the practical, but which in large engines becomes of considerable amount by the superior vacuum obtained when steam is greatly expanded; for in this diagram the better vacuum increases the steam pressure when the steam is cut off at one-third stroke a full one-fifteenth part more than when compared with steam at full stroke; hence alone there is one-fifteenth part

additional power to be gained, which is now lost in these engines, in addition to that great gain from the employment of expansive steam.

But the gain of the incalculable information contained in and derived from the diagram, is the full proof of that most desirable fact, that the full efficiency of steam is to be obtained from the expansion of low steam; hence we shall find the unlimited and inestimable advantages of steam may be obtained without its horrors and indescribable afflictions, and which are the more dreadful and disgraceful because the use of high steam is as unprofitable as inhuman.—*American Repertory.*

ADVANTAGES OF COMPRESSED PEAT. By Alexander S. Byrne.

(Continued from page 248.)

The preceding paper shows the value of peat in the manufacture of iron; but it may be profitably used for other important purposes.

Fuel.—It is of great value as fuel for furnaces and firing of every description, more especially so when coked and mixed with coal, or coal tar, or resin, pitch, and such like substances. Mr. Charles Williams, managing director to the Dublin Steam Navigation Company, a gentleman of experience and practical information, recommends a mixture of peat coke and resin for steam vessels. From his statement printed in the Transactions of Civil Engineers, London, it appears that one ton of resin fuel, (i. e. peat coke and resin) thrown in front of a coal fire is equal to three tons of coal.

For every description of firing, peat coke is invaluable. Its freedom from injurious and unpleasant exhalations, its durability and extreme brilliancy, are among its chief recommendations. What is so cheering as a brilliant fire! Of domestic comforts it is certainly one of the chief. For such purposes peat fires are unequaled. They are beautiful and pleasant, affording an *intense* heat, and a pure white and yellow flame, not surpassed by the finest coal.

Coking.—This is accomplished by means of heat. There are several modes of coking compressed peat: in every instance atmospheric air is excluded, and passages left for the volatile products to escape, as explained under the head *Pyroligneous Acid.* Some employ large brick chambers, with a hole at the top, a door at the side, and gutters at the bottom for the tar to escape: others form piles of various shapes, and cover them with loam, to screen the burning heap from a too free access of the atmosphere, which would otherwise consume it entirely. In some districts, large coking ovens are preferred; in others, a sort of iron hood; and in others, the use of large iron retorts. In every instance it is important that the process be conducted as uniformly as possible; that the escapes for tar and gaseous products be perfectly free; and that the mass undergoing carbonization be so distributed that the *whole* be acted on at the same time. Charcoal obtained by the action of rapid fire is always inferior to that obtained by slow calcination in pyramidal piles.

For softening steel plates, charcoal from turf moss is equal to the hardest oak; for the production of gunpowder, many varieties are superior to dogwood and alder, and for crayons it is equal to the finest willow. Much, however, depends on the mode in which it is burnt.

Gas.—Peat is very valuable for the production of gas. We have made considerable quantities in England and in Ireland. Prof. Maugham, of the Polytechnic Institution, London, one of the first practical chemists in that city, was induced to examine the subject, in consequence of our experiments in Ireland, and he has announced his opinion that peat may be so employed to considerable advantage. It has been severely and advantageously tested upon a large scale in Dublin, Paris, and Plymouth. Some

kinds of peat (top surface) yield three times as much gas as coal; but as a general rule it does not yield more than Wigan or New Castle coal: it is, however, far superior in brilliancy and power.

There was an objection to this gas, which for a considerable time destroyed all hope of rendering it useful, and severely injured the works erected for its production. In the distillation, an impalpable powder came over with the gas, which washing and re-washing would not remove, and it eventually deposited itself in the pipes and in the holes of the burners, and stopped them up. To remedy this evil, it occurred to us to use oil in the purifiers instead of water, which, we are happy to add, answered to the fullest extent. We have also found that oil acts as an excellent purifier for every kind of gas, and greatly improves its quality. The expense is trifling, as the oil when boiled becemes clear, and leaves all impurities at the bottom. Gas passed through *boiling* oil is still better. When mixed with coal in equal quantities, and calcined in the same retort, the peat at the bottom and coal on the top, the coke and gaseous products are superior to those obtained from the finest coal. The brilliant appearance of peat gas, and its *intense heat*, has been matter of surprise to those engaged in its production. Persons unacquainted with the secrets of a gas-work have urged as a reason against the use of peat gas, that it burns away in less time than gas from coal. In answer to this objection we would observe, that it is not true from a pure top-surface peat, but only of the lower beds; and being more brilliant, a less quantity will give as much light: also, that twice as much peat can be distilled in the same space of time; consequently, *twice as much coke can be obtained*, and at the same expense. Coke is considered *the most valuable* product in a gas-work.

Pyroligneous Acid.—When subjected to decomposition by fire, peat gives off condensible acetic vapors; its elements being separated by the action of heat, and reunited in another order, produce compounds which did not exist before. The proportions of these products differ in the same substances, according to the degree of heat applied, and the skill with which the operation has been conducted. The quantity of crude acid produced from turf-moss, and peat collected from the top surface, is very great.

For this purpose, the apparatus used in the manufacture of coal gas, or wood vinegar, may properly be employed. This consists of large air-tight cylinders, condensers, purifiers, stills, &c. The compressed peat, well crushed and broken, is to be put into retorts, their doors having been closed and luted with clay. Each door has a small vent, capable of being closed by a stopper or valve. The use of this vent is to allow the volatile products which are given off during calcination to escape; and the use of the stopper is to close the vent so soon as the calcining matter ceases to give out such vapors; or supposing, as is usual, another vent to be in the upper part of the retort, then it allows the operator to watch the process of calcination. Within each retort passes a rod, revolving upon its two extremities as points; the one end resting on the farther extremity of the retort, and the other in a hole in the stopper, capable of being closed by a cap. This rod has at one end a circular plate; and at equal distances along its length are fixed fans or spokes, perpendicular to the axis of the retort. The use of this apparatus is to stir and divide the matter while in calcination; and it does this when the stopper is removed, and a key is inserted into the rod, and turned round, causing of course the rod with its fans to revolve on its axis. The use of the round plate is, when the matter is perfectly calcined and the door is removed, to draw it forward, and rake it out with as little delay as possible into proper recipients placed in front.

The retorts should be heated to a pale cherry red before they are filled; and as soon as they are rendered air-tight by the closing of the doors, the process of decomposition begins, and the volatile products, consisting of gases, vegetable tar, and pyroligneous acid, being separated, pass off through an aperture in the top of a retort, to which pipes are attached, leading into condensers: these pipes are generally *wormed,* and inclosed by a stream of cold water. The gases may be purified, and collected in a gasometer to be burned, or turned off by means of a pipe into the fireplace. The condensed liquors are then allowed to settle: the vegetable tar falls to the botton, and the crude liquor is separated by decantation from the empyreumatic oil associated with it, and re-distilled in the ordinary way. The odor peculiar to this acid may be easily removed by agitating it with oil, and distilling it with sub-carbonate of potash and animal charcoal: or the vapors which pass over, during distillation, may be purified with greater effect by passing them through oil.

It is to be observed that the volatile matter which is allowed to escape during calcination is all valuable. The tar is useful as a varnish; or being subjected to distillation by itself, it affords crude pyro-acetic spirit, naphtha, kreosote, &c. The gases may be employed for illumination; and the crude acid may be employed for preparing acetate of iron, acetate of alumina, and acetate of lime (used in calico printing;) or it may be used for the production of pure acetic acid, and the best household vinegar. The charcoal which remains in the retort is superior to wood charcoal, and may be used as fuel.

Roads, Pavements, &c.—Peat does not answer alone for these purposes, being of a pulpy nature when wet, and too easily pulverized; but when combined with an artificial asphaltum, composed of carbonate of lime and coal tar, it forms a solid and elastic road, superior in many respects to wood or native asphaltum, and presenting a surface which in all seasons affords good footing for cattle. The tendency of this artificial asphaltum to crack and break is counteracted by the strong fibre of the turf, which, if added to the chalk and tar while warm, acts as a *binder* when the mass is cooled, and obviates its brittleness. In this respect peat is analogous to hair in mortar.

For Cabinet and Ornamental work, it is only necessary to use the peat when warm. It may then be moulded to any form, and afterwards hardened in alum water, varnished, or covered with metalic solution, to render it impervious to water. When properly compressed, it can be worked in the same manner as wood, and is capable of sustaining a very high polish.

Having said so much on the properties and uses of peat in compressed and other states, we would remark, in conclusion, that where density is not a considerable object, peat can be advantageously worked in good brick machines, provided the superabundant water is evaporated, and the operation completed, while the peat is warm.

We sincerely hope that these observations may induce our friends in Ireland to provide suitable employment for the laboring poor of that country, and that her desolate moors may soon become, as was once said of them, "mines above ground."—*American Repertory.*

The Thames Tunnel.—The famous Thames tunnel, as is well known, is now near completion. The mode of egress, for foot passengers, is to be a spiral staircase. The carriage way is to be spiral, and two hundred feet in diameter. The gradients of the road will be about one foot in twenty-five, forming an inclination by no means inconveniently steep.

SIXTH SEMI-ANNUAL REPORT OF THE ENGINEER OF THE CENTRAL RAILROAD AND BANKING COMPANY OF GEORGIA, TO THE PRESIDENT AND STOCKHOLDERS.

In making the present semi-annual report of the operations of this department, and the condition of the work under its charge, I take great pleasure in announcing to the stockholders, the final and complete location of the road to the Ocmulgee river at Macon. The work has been one of great labor, and has occupied the time and exertions of a party of Engineers who have been engaged in the special service for nearly four years. The complex topography of the country through which the upper portion of the line runs, and the various routes that presented claims to an examination, have rendered these protracted and laborious surveys indispensable.

Four different routes have been surveyed between the Oconee and Ocmulgee rivers; and each successive survey has shown a line improved on the previous one; and it is confidently believed we have at length selected one that could not be much further improved. We have been able to keep our planes within the maximum inclination of 30 feet per mile, and have no curves on a shorter radius than 2000 feet.

The excavation and embankment are reduced to a much smaller quantity than we at first even hoped for; and the character of the material for the most part, is such as to allow its removal without the aid of the pick or even the plough. Pine timber of the best quality, abounds throughout the whole route, and although we shall encounter no rock in our excavation, it can be obtained at reasonable distances from the points where it will be required for masonry.

To the untiring perseverance, good judgment, and scientific qualifications of my principal assistant, Mr. Franklin P. Holcomb, I take pleasure in ascribing the credit which is eminently due him, for the selection of so favorable a route; his duties have always been performed with cheerfulness, and in the most thorough manner. His labors have been faithfully seconded by the several gentlemen composing his party, who have also just claims to my approbation.

In my previous reports, I have described the route to the Oconee river; it will be borne in mind that the line approaches the Oconee by the valley of Sandhill creek. This creek joins with Buffalo creek, as it enters the Oconee swamp, and our line in passing through the river swamp on the east side, crosses several lagoons and branches of Buffalo creek. The distance from the high ground to the river, is little short of a mile. This is the lowest part of the river swamp, and the road will be passed over it, on truss work, founded on piles, for about a distance of 4000 feet, to the bank of the river.

The width of the river at the time the line was located, was 140 feet, and the depth, in the deepest part, about 8 feet; this however was at its lowest stage. The plan adopted for the main bridge, is the lattice plan, invented by Mr. Town,—the length of the bridge two hundred and fifty feet, to be supported by two abutments and one pier, of stone; the bottom of the bridge will be elevated 22 feet above the surface of the water at its lowest stage, and the grade of the road will be five feet above the height of the great freshet in June last. On the west side of the river, the swamp is about two miles in width; this will be crossed by an embankment, averaging about fifteen feet in height, with an opening near the middle of 1000 feet of truss work, making in all, a water-way of about one mile, to vent he water of the Oconee river.

It is a very fortunate circumstance, that we had such an indication as the last great freshet to guide us, in fixing the grades of our road across this river, and determining the character of the structure of that portion of the work. The celebrated Yazoo freshet, would otherwise have been taken as the high water mark and that did not reach the height of this last flood, by nearly five feet, at that point.

Having thus passed the Oconee river, we find ourselves near the mouth of Commissioner's creek, which discharges itself into the river about a mile and a half below our line; about four miles from the river, the line crosses to the south side of the creek, and follows its valley for the distance of twenty-six miles; then leaving it we pass with a cut of thirty-one feet (which is the highest point of land the road crosses, being about 500 feet above tide water) into a prong of Big Sandy creek—following this stream, with a descending grade, about two miles, we cross it, and take another branch of the same creek, which we keep for about the same distance; thence across the main branch of Sandy creek; by a small branch we ascend to the summit between the Oconee and Ocmulgee rivers—here we have a short cut of thirty-two feet depth at the highest point; falling into a branch of Swift creek, which we follow a mile and a half, then cross the main creek; and taking and taking another branch of Swift creek, we reach Boggy branch, which leads us to the valley of the Ocmulgee. In crossing from Swift creek to Boggy branch, we encounter the deepest cutting on the line, which at its greatest depth is forty-one feet. After reaching the river valley, about three miles below the City of Macon, we keep along the low grounds, and enter the river swamp near the great mound; the line crosses the river, about half a mile below the bridge, and terminates on the flats at the foot of Cherry street in Macon,—the whole distance from this city being 190 miles, 3900 feet.

In the event of terminating the road on the east side of the river, we should deflect by a curve to the right, commencing near the mound; and run along parallel with the river, to such spot as might be selected for a depot.

For a distance of 25 miles from the Oconee swamp, the work is for the most part light, with occasional short cuts and fills; the remainder of the distance about 16 miles is rather heavy, compared with other parts of the line. I have taken the precaution to have wells dugs in the principal cuts, to ascertain the quality of the material to be excavated, and find it to be of the most favorable character. The cuts are composed of a mixture of sand and clay, easily removed by the shovel.

On the subject of the termination of the road at Macon I am of opinion that the interest of the company, and more especially that of the city of Macon, would be best promoted by crossing the river.

It appears to me that the free and constant intercourse which will necessarily be kept up by the business community, with the depot, requires the removal, as far as possible, of every obsticle to such intercourse; and that the intervention of the river, would be, in some degree, a hindrance to the transaction of business; but more especially in the event of the destruction of the present bridge by fire or otherwise. Should the road be carried across the river, the bridge would of course be so constructed as to be used exclusively for the passage of the trains, and would therefore be no injury to the present one, in the matter of travel. There will be no difficulty in selecting a favorable site for a depot in either case. The additional expense to the company by crossing will, be about $30,000.

The grading of the whole of the line not under contract is advertised for letting at Milledgeville, on the 5th day of next month; and I flatter myself that we shall have no difficulty in putting it under contract; should this be

done I think we shall be able to reach Macon with the superstructure by 1st January, 1843.

The work has progressed steadily on the grading contracts for the last six months; the total distance graded is now about 143 miles and the superstructure is completed 126 miles

The 2000 tons of iron last ordered, has all been received, and will be sufficient to extend the track to the distance of 139 miles. Our trains are now running regularly to Hardwick's, 122 miles from the city, and although the cotton crop has been unusually late, and very short, our business has been, during the last six months, nearly double the amount of the same period last year.

Receipts of the road for 12 *months, ending* 31*st Oct.* 1840.

Up freight.	Down freight.	Mail.	Passengers. No.	Passengers. Amount.	Total.
$44,425 09	$34,817 74	$3,792 32	11088	$30.792 36	$113,827 51

[The above is exclusive of the transportation of iron and other materials to a large amount, for the uses of the road.]

The expenses of the transportation department for the same time, have been	$23,276 16
Repairs of road,	$11.075 31
Total,	$34,351 47

The average distance in operation, during the past year being about one hundred and ten miles—the cost of repairs has therefore been about one hundred dollars per mile.

The opinion has generally prevailed, that a railroad, to be profitable to its stockholders, must have a large amount of travel—that the only source of profit is in the transportation of passengers, and that as a general rule, the freighting of heavy commodities, yields little or no profit to the company.

The experience thus far, on our road, demonstrates in the most satisfactory manner, the error of this opinion. It will be perceived by the above statement, that our freighting business has more than doubled the amount of that of passengers, and mail—and this has been done under the disadvantage of having but one train for both purposes, consequently keeping up a speed altogether too great for the most advantageous transportation of freight. I have no doubt that freight trains run separately from the passenger trains, with full loads, and at a velocity not exceeding ten miles per hour, would yield as much profit per trip, to the company, as passenger trains carrying fifty passengers each way.

The present terminus of our road, is by the wagon route, 70 miles from the city of Macon. Notwithstanding this long portage over a bad road, we have had, during the present season, nearly all the freight for that city. There has been an average of 200 wagons, running during the last three months to and from the depot. I am confident that the merchants will find it to their advantage to abandon altogether the steamboat business, on the Oconee and Ocmulgee rivers

Our machinery and motive power department, is now as complete as the necessities of the road require. Since my last report, a locomotive engine, from the manufactory of Messrs Rogers, Ketchum and Grosvenor (the Oconee) has been added to our motive power, making our whole number eight. The superstructure of the road continues to maintain its grade and allignment, and the small amount expended in repairs, as before stated, has kept it in good repair. Some of the timbers first laid on the lower portion of

the line, have decayed, and we have, during the past year replaced them. Contracts have been made for the delivery of timber at different points along the oldest parts of the road, for the occasional renewal of such pieces as may be decayed.

The operations of the road have thus far been conducted *without the occurrence of a single accident resulting in personal injury to any one.*

Should we succeed in letting the grading, as we have reason to expect we shall, on the 5th of December we shall, be able to complete the road, without receiving aid from abroad in the way of pecuniary means. It will be a subject of just pride to the friends of the institution should an undertaking of such magnitude be carried through with their own resources, unaided by foreign capital. I take pleasure in congratulating them on the prospect of such a result.

Respectfully submitted,
L. O. Reynolds, Chief engineer.

Steam Navigation.— It is remarkable that this science, did not for many years after its invention and application, make such progress as one would conceive its palpable merits and advantages entitled it to. It was not until the year 1828 that the navy of England possessed a single steam vessel, and in 1835 we had only twenty one of the aggregate of 3000 horse-power. From that date this species of force has multiplied greatly, and now amounts to nearly eighty, under the pendant of 11,000 or 12,000 horse power. France has done her best to keep pace with us, having between forty and fifty steam vessels afloat and building, but none equipped of more than 220 horse power. By arming her packets she makes considerable display; but her resources for increasing this force on emergency are feeble as compared with our own, for the mercantile steam tonnage of the United Kingdom, progressing as it is in a prodigious ratio, presents the most stupendous element of naval power (by giving facility of operations) that the world has ever witnessed. We recollect when the expedition for the attack of Copenhagen was projected, in 1807—the completest and best appointed expedition that ever England sent forth—although preparations were commenced in March, it was not until so late in the season as the 26th of July that the first division of the fleet sailed from Yarmouth roads, leaving but little time to execute the objects of the campaign before the winter set in. Now, England at this moment possesses such an amount of steam tonnage, (according to the last official returns published 810 vessels, 157,840 tons, 63,350 horse power,) that a portion of it could convey the necessary troops, with all the usual appandages, and tow a squadron of ships of-war to the scene of action, in less than one quarter of the time occupied in the former expedition, should circumstances ever render it necessary for us to occupy the island of Zealand, or any post in the Baltic. The fact is that steam navigation, not only as directly applied to vessels-of-war, but in aid of combined expeditions for sudden descents upon different points, enables the country possessing it in the greatest force to harass an enemy's coast with a small but well appointed army, and to carry destruction to every town and village within a dozen miles of the sea, unless they are regularly fortified and garrisoned, or covered by large bodies of troops. It is stated by an old author, that "in the year 1647 the Dutch with a fleet and but 400 men on board, alarmed the whole coast of France, and obliged the French king to keep near 100,000 men upon the maratime coast, as not knowing where theywould fix."

If such was the case with vessels when movements were dependent on

winds and tides, and whose operations were under such circumstances necessarily slow, how much more so it will be with the aid of steam, when, by this means, vessels of light draught, heavily armed, not a boat will be permitted to pass out of gunshot of the shore, nor a harbor left open for egress or ingress any day in the year.—*London Naval and Military Gaz.*

Armed Steam Craft for the Lakes.—A correspondent of the Cleveland Herald, writing from Chippeway, U. C. says:

I have been permitted to visit Her Majesty's steamer, building at this place. She is called the *Minos*, in honor of the first King of Crete, who, according to heathen mythology, was after death promoted to the rank of *chief fireman* in the regions *de'l Enfer!*

She is 148 feet on deck, and registers 400 tons, and is built in every respect a "man of war." She is of great strength, her timbers being placed close together, are caulked and pitched before planking, so that in the event of starting a butt, she would not leak; a very desirable object in armed vessels. On the inside, parallel bars of iron are let into the timbers the entire length of the boat, and placed six or eight inches apart. This does not add materially to her strength, but renders her almost shot proof. Her planks are five inches and her sealing three inches thick, making her entire thickness about twenty-two inches of solid timbers.

She is fitted with two 45 horse power low pressure beam engines, from the manufactury of the Messrs. Ward, Montreal, which are placed entirely below deck, on the plan of the Atlantic steamers, and are beyond the reach of external injury; but they are, in my opinion, of too small a calibre for so heavy a boat.

The engines are supported by iron frames resting upon large fore and aft timbers, placed on either side of the kelson, which are securely bolted and fastened to the deck frame of the boat, and will, instead of weakening the boat, add greatly to her strength. The cylinders are 26 inches in diameter, with four feet and a half stroke, placed upright in the usual manner, but in place of one working beam to each engine playing above the cylinders, as is customary, they have two, *reversed*—one each side of the cylinder, and moving close to the floor of the boat. The piston rods act upon a cross head, as in the common square engine; but the connecting rods, instead of leading directly to the cranks, are fastened to one end of the working beams below, and through them transmit the power by means of other connecting rods, to another cross head which is attached to the cranks; thus giving regular and continued motion to the entire machine. The grates and boilers are arranged expressly for burning bituminous coal, and her "bunkers" will contain from 10 to 1200 bushels.

The magazine occupies all the after part of the hold, under the cabins of the officers, and is in as secure a place as there is about the ship, being below the reach of shot, and out of the way of fire.

The *Minos* is schooner rigged, and shows a clean deck fore and aft; and were it not for her funnel and wheel-houses, would look like a large schooner, as she has no guards or upper works of any kind. She is expected to mount eighteen pound carronades and two mortars for shells in case of a bombardment.

The part of the vessel forward of the engines is fitted as a mess room for the "people," and is a very comfortable place, having short tables for each mess projecting from the sides of the boat, and shelves and lockers in abundance for accommodation of their traps. The main hold is underneath the "people's" mess, and will contain abundant room for stores for a long cruise.

supplied either from the hot well by the engine or from any other source.

Now, as the feed-pipe of a low-pressure boiler is only required to be of sufficient length to hold such a head of water as will, by its hydrostatic weight or pressure, balance the greatest elastic force of the steam intended to work the engine, it is evident that as soon as this limit is exceeded, the water in the feed pipe will be liable to boil or prime over, and, consequently, under such circumstances, the boiler becomes as perfectly safe as any ordinary open-topped pan of the same height as the top of the feed cistern.

From the above description we see the inutility of a safety valve on a low pressure boiler, except for the purpose of blowing off the steam occasionally, and thereby preventing the inconvenience resulting from boiling over; and this is accomplished generally by means of a valve placed on the steam pipe leading from the boiler to the engine, so as to be at hand for the engineer to blow off when required, previous to stopping the engine.

Many people we know strongly recommend a safety valve to be placed on the boiler itself in addition to the ordinary blow valve of a low pressure boiler, but in the case of a boiler fitted up in the manner we have described, any one may perceive it would be perfectly useless, *and therefore, practically injurious.* In saying this, it is not of course, to be understood that any harm can accrue from an extra safety valve abstractedly considered, but only as it is a means of withdrawing attention from other more obvious means of safety. In this view of the subject the safety valve may be aptly compared to Sir Humphrey Davy's celebrated safety lamp for coal mines, of which it is frequently said, and we think truly, that for every life it has saved it has been the means of destroying twenty, by inducing a negligent attendance to improved systems of ventillation.

The common feed pipe of a boiler is, in fact, a *safety pipe*, and very much superior in all respects to any safety *valve* that can possibly be devised, the moveable column of water within the pipe answering the purpose of both valve and weight; and it is justly considered as a beautiful example of the general superiority and simplicity of using hydraulic means in accomplishing objects of this kind, over the ordinary mechanical contrivances. In the most improved arrangement for this purpose, (we allude to Mr. Elsworth's hydraulic joint for superceding the stuffing box of the buoy-rod,) if considered as a safety valve, there is this essential property, *it cannot be overloaded* or tampered with in any respect; besides, it is impossible for it to *stick* or get out of order, because it is continually on the move, and that without wasting any steam.

Until within the last two years there were probably 400 to 500 boilers working in Manchester without safety valves, but nine out of ten of them, at least, were fitted up with the common feed pipe as above described; yet the proportion of fatal accidents from explosions of boilers in Manchester are almost as nothing in comparison to the number that occur in steam boats, although, in the latter, the boilers are always supplied with at least one safety valve.

The fact is, that, both in high and low pressure, the chance of an explosion occurring is more dependent upon the mode in which the boiler is supplied with water than upon any thing else, and although the common feed pipe is not so applicable in steam boats as on land, yet a safety pipe acting on the same principle might be very easily applied, and would serve as an infallible check against the water getting too low as well as against the steam getting too high, if made with its lower end to terminate a little above the flues, so as to allow the steam to blow away whenever the surface of the water in the boiler descended below that point.

A patent safety pipe has, we understand, been tried in London, but it is

so contrived as to *put out the fire*, by boiling over into it, whenever the steam gets too high, which property would be perhaps in many cases an inconvenient addition, although not half so bad as an American safety pipe which has very recently been puffed through all the newspapers, and which is described as having the following curious property: *when the steam is too high it shuts the furnace door quite close, so as to make it impossible for the fireman to open it* to supply more fuel. Now if this patent contrivance had been made to act quite the reverse, or to have *opened* the furnace door as we do in England, instead of *shutting* it, the invention might have been useful; but as it is, it is much more calculated to cause explosions than to prevent them.

ON THE STEAM ENGINE.

(Cotinued from page 278.)

In a previous paper we quoted Mr. Palmer as stating the maximum effect that nature is capable of accomplishing to be 44,467,500 lbs. raised one foot high, with one bushel of best Newcastle coals, in the absence of all *friction.* And at the same time we stated that a Cornish pumping engine, in London, had performed a duty of 72,000,000 lbs. besides the accompanying *friction.* According to a later report, the same engine has performed 92,000,000 lbs. duty, besides friction—Welsh coals having been used, and the steam cut off at $\frac{1}{3}$ of the stroke; which latter circumstance we wish particularly noticed, as corresponding with our experience, and because we shall have to allude to it hereafter. It here appears that the *duty actually performed* by steam is more than double the utmost power that steam possesses, as Mr. Palmer understands and states it. How great then his error becomes, when the *friction* is added to the duty, which in the Cornish engines is frequently much more than the duty itself; and how clearly it appears that he did not know one quarter part so much of the true value of steam as the Cornish engineers whom he so presumptuously undertook to rebuke.

The friction of the Cornish single pumping engine has been treated by Mr. Wickstead as single also; now, although the action of steam, from its being confined to one stroke in these engines, is single, yet the friction extending alike to both strokes of the engine and the pumping machinery also, is double, and the joint amount truly enormous, from the great mass of matter to be moved, of which the timber pump-rods alone, 12 to 14 inches square, extend perpendicularly 700 to 800 feet or more, and in many instances to great distances horizontally. In none of the reports of duty by the Cornish engines are these important contingencies either described or alluded to with the attention they deserve or that is required for a due considertion of the subject, but are all indiscriminately merged into the comprehensive term "friction;" and this being doubled by the peculiar formation of the engine, is necessarily prodigious as it appears to be in Mr. Henwood's tables, in 2d vol. Journal Inst. Civil Engineers. Hence, the reported "duty" of these engines has been only the inadequate representative of a portion of their *power;* for it must be readily conceded that all power wasted or misapplied is as truly power as that usefully employed; and this latter portion alone has the duty hitherto truly represented.

The annexed table is abstracted from Mr. Henwood's lucid and valuable description of his careful experiments on the best engines in Cornwall. It will be seen that Watt's double condensing engine, an estimate by Professor Renwick of the loss of power of which we condemned in a formar paper as extravagant, and justly condemned as we shall hereafter prove, becomes by contrast with these in the table the very mirror of economy.

ABSTRACT FROM HENWOOD'S TABLES.

EAST-CRENNIS. Cyl. & steam pipes cov. with sawdust	BINNER DOWNS. Cyl. & steam pipes heated with fire.	HUEL-TOWAN. Cyl. bottom and cover steam cased		ENGINES.
76	70	80	in.	Diameter of Cylinder.
10	9	8	in.	Steam. — Diam. of Valves.
14	12	12	in.	Equilibrium. — Diam. of Valves.
16	[illegible]	16	in.	Exhausting. — Diam. of Valves.
10.25	10.00	10.00	ft.	Cylinder. — Length of Stroke.
7.16	7.50	8.00	ft.	Pump. — Length of Stroke.
26 two of	33	36	in.	Diameter. — Air Pump.
4.5	4	4.0	ft.	Stroke. — Air Pump.
1920	636	1080	cub. ft.	Water in Boiler.
650	350	700	cub. ft.	Steam in Boiler.
88.2	89.2	93.8	deg.	Temperature of Hot Well.
67.0	52.3	64.7	deg.	Temp. Condensing Water.
37.5	48.0	72.0	sq. ft.	Area of Fire Grates.
57	76	114	sq. ft.	Surface exposed to action of Flame.
2500	1440	2600	sq. ft.	Total heating Surface exposed.
26.3 / 36.8	58.0 / 74.78	61.8	lbs.	Absolute Steam Pressure in Boilers per sq. inch.
$\frac{2}{5}$ / $\frac{1}{3}$	$\frac{1}{7}$ / $\frac{1}{9}$	$\frac{6}{13}$		Times Steam is expanded.
21 / 25	25 / 26	27	lbs.	Absol. steam in cyl. per sq. in.
11.4 / 11.4	10.2 / 10.23	10.2	lbs.	Load per inch on area of Piston—Useful Effect.
9.6 / 13.6	14.8 / 15.7	16.8	lbs.	Friction—Loss of Power—Useless effect.
$22\frac{1}{2}$	25	$24\frac{1}{2}$	hrs.	Duration of Experiment.
3005 lbs.	[illegible]	Bu 50= [illegible]		Coals consumed.
1	1	1	Pts.	Oil used.
17	$15\frac{1}{2}$	20	lbs.	Grease used.
4,7[illegible]	11,258	7,881		No. strokes made by engine.
3.5	7.49	5.35		Strokes per minute.
1.7	1.34	1.6	sec.	Duration of working stroke.
4.17	4.23	4.8	sec.	Duration of return stroke.
11.2	2.4	1.8	sec.	Interval between strokes.
870	1006	1085		Tons lifted 1 foot for 1 farth.
73,502,69	74,395,[illegible]23	77,533,107		Duty in lbs. lifted 1 foot with 84 lbs. dry coal.

The tables from which the preceding is compiled contain very careful descriptions of important *facts*, to which we have added a column with the nearest vulgar fraction, denoting the quantity of steam expanded, and another column for the "friction," or power wasted or uselessly expended, to show at a glance, without trouble, the actual advantages or disadvantages of using steam of various densities.

Let us now compare these *facts* with a table and statements from Prof. Renwick's Treatise, p. 157.

"*Relative powers of an engine using the same quantity of fuel, and acting expansively at different tensions.*

Force in atmospheres.	In lbs	Cylinder filled.	Effective force
$1\frac{1}{6}$	17.5	wholly.	10.00
2	30.0	$\frac{1}{2}$	10.75
3	45.0	$\frac{1}{3}$	27.50
4	60.0	$\frac{1}{4}$	35.60
5	75.0	$\frac{1}{5}$	43.50
6	90.0	$\frac{1}{6}$	51.00

It will therefore appear, without any change in the general distribution and plan of an engine, provided the boiler be strong enough to bear the increased force of the steam, its power may be readily increased five-fold.

Again (p. 158;) "This method has been brought to the test of actual experiment, in the pumping engines in the mines in Cornwall, and by its use the power of an engine of a certain nominal horse power has been increased five-fold."

Again (p. 160:) "In this way the force of steam has been gradually raised from little more than a single atmosphere to ten; and an intelligent Cornish engineer states he has seen it raised to 20 or 30 atmospheres."

Now it is most desirable and essential that this bold theoretic statement should be examined by competent persons, whose examination might confirm it if right, or disprove it if wrong, for the sake of the public weal—for the many individuals interested in such a multitude of respects—and for the national character, which cannot fail ultimately to be seriously affected by the currency of such opinions, and by the dangerous practice recommended from such an illustrious source.

Now if Professor Renwick is right, if this his statement is true, it is as evident as the sun at noonday, that the power of an engine using the same fuel and expanding the steam, may not only be readily increased five fold, but ten fold or more; because this plausible theory is altogether based and depends upon an unlimited gain being attainable from a limited cause—stripped of its learned disguise, it would be as unfounded, as were the opinions of those unfortunates seeking perpetual motion.

To prove the unsoundness of these views, as we may, and desire to do, without discussion, we have only to bring the theoretic statements into juxtaposition with Mr. Henwood's experiments, which in density of steam, and in times expanded, though all purely accidental coincidences, are as impartial and correct trials of the theory as could have been contrived by man.

Thus, then, the duty of the Binner-Down engine using steam of 75 lbs. elasticity, should have been 300 millions, or more than four times as great as the duty (73 millions) of the East-Crennis engine, using steam of 26lbs. elasticity. But the difference in the duty of these two engines, tried so carefully under circumstances all corresponding with the theoretic statement—with steam exactly corresponding with those prescribed, from which such great advantages are unhesitatingly promised—this difference of duty

instead of being as stated, 3 times the duty of the East-Crennis engine, appears less than the $\frac{1}{75}$ part thereof; and even this almost insensible quantity is probably the result of mere accident.

Hence, then, it has been satisfactorily and experimentally proved that steam of 75 lbs. per inch expanded, is of no greater value whatever than steam of 26 lbs. per inch used expansively; we are thus allowed the choice of only two opinions—either the learned theorist or the unlearned steam-engine must have been mistaken; and, hard though as it may be, we have no doubt this uncandid world will be far more ready to attribute the mistake to the former than to the latter, which from natural dulness and incapacity, will probably be pitied rather than blamed. But the theorist may even then amply console himself by reflecting, how difficult it is to find an engineer who is not just as much mistaken as himself on this particular subject, for the very construction of these Cornish engines, and their using steam of such different densities, evidently prove a seeking for some as yet undiscoverable advantage. If he wants farther consolation, let him observe the uncertainty that prevails in the construction of engines, scarcely any two being built alike—or the more brilliant example afforded by the splendid public experiments in which the United States government indulges, who from mere inability to discover the wonderful advantages anticipated in that most exquisite of all steamers, the Fulton, are building two more on different principles and at a venture, determining if possible to discover the hidden perfections of the first. Now we have shown in this paper that one of these second thoughts, the British marine engines is a poor affair to copy—in our next we will show the other is worse.

If he does not then receive full consolation, let him observe how readily and constantly in all countries is a plausible and lazy, if brilliant, fiction preferred to sober facts demanding study and serious attention. Were facts substituted for fiction in this matter, however trivial they may appear to a superficial and careless observer, it would soon be seen that on the proper application and appreciation of them such an immediate great and general improvement of the steam-engine would ensue, as in its various and total results can hardly be overstated by the most sanguine admirer of that mighty instrument of civilization.

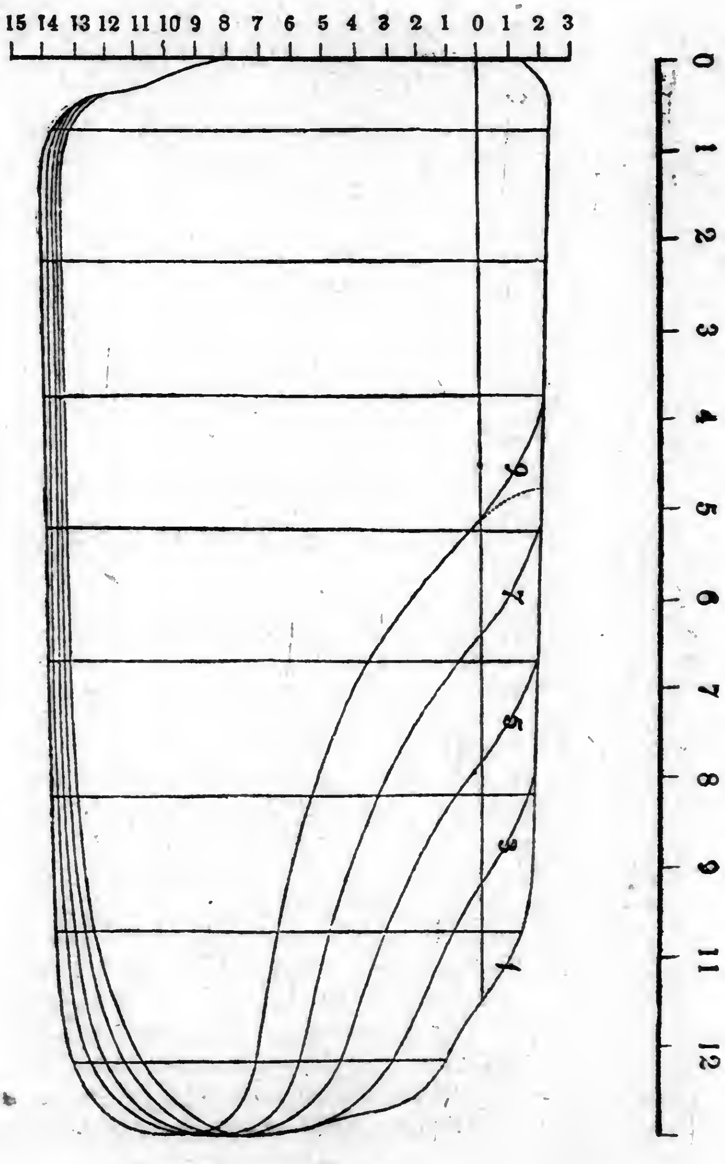
It is in continual shadow hunting that substantial truth is overlooked, and great and real advantages are disregarded; would engineers but condescend to examine and appreciate the true nature of expansive steam; would they but condescend to be satisfied with the great and real advantages it possesses—would engineers, (we ask not philosophers) condescend to disburthen or to cease from burthening expansive steam with useless conditions and pernicious and visionary restrictions, destructive of its usefulness, immense improvement would immediately ensue, and soon become general in the steam engine, which luckily never yet became a theorist, and therefore will ever and constantly be found obedient to reason.

Now we have shown, page 162 of this essay, that it is commonly a matter of great, if not perfect indifference, if from a given volume of water and heat whether high steam or low steam is formed and employed to produce motive power.

We have also shown, page 164, the value of gain from steam expanded is ever definite, and proportional to the density of the steam before its expansion. From these two positions it necessarily results, that whether proportional quantities of high or low steam be expanded to produce motive power, the superior quantity of the weaker expanded steam acting on a larger suface, will always compensate for the superior density, but lesser quantity of the denser steam acting on a lesser area; and these two distinct

actions of high and low expansive steam will be precisely equal, leaving for future consideration some disturbing forces not now pressing for immediate discussion, and which can be more satisfactorily treated hereafter. These equal actions, though so contrary to the current and popular opinions universally prevailing, are positive facts, necessarily arising from the definite nature of steam definitely expanded within a heated cylinder, and these its certain and invariable qualities are proved to the very letter, and as perfectly as the sagacity of man can devise, by Mr. Henwood's experiments on the Binner-Down and the East-Crennis engines; and just as plainly, fully, and satisfactorily are Professor Renwick's theoretical statements contradicted.

We shall attempt to establish an important and invaluable truth on the destruction of this extensive and dangerous error by which the utility of the steam engine has been much lessened, and happily we shall be just as able to produce undeniable facts in proof as we have already done for all our assertions; so that in every thing we are about to adduce, we shall be supported by indisputable evidence.



For this purpose we annex a fac simile of a diagram described by an indicator attached to one of the engines of the Great Western steam ship, and like the " handwriting on the wall," it greatly excels the handwriting of man. It gives a clear insight and full detail of the true internal state and power of the engine under varied circumstances, its capacity for improvement and even the acquirements of the manufacturing engineer—matters essential to be known and difficult to be otherwise determined. The diagram shows the steam as cut of by cams, (9) five of which are numbered and their effect ascertained, besides that of the slide movement. This engine is undeniably experimental, and the production of a mind seeking and not possessing information of the most essential character conceivable in a marine steam engine.

$$
\begin{array}{rl}
8)120.45 & \\
\hline
15.05 & \\
1.05 & \text{deduct for friction.} \\
\hline
14.05 & \text{effective pressure per square inch.}
\end{array}
$$

On the proper application of steam evidently depend the form, dimensions, and weight of boilers, water, space and weight of machinery, the quantity and cost of fuel and labor, and the portion of freight usefully employed for those purposes. In fine, the speed, expense, and profit of steam navigation evidently as much depend on the proper application of steam, as this again must ever depend on a knowledge of its useful and definite properties. All these are vital matters in steam navigation on the ocean, and are in those engines much miscalculated, and evidently not yet understood.

The journal of the British Queen steam ship, page 50, vol. i. of this work, will show how far behind the age are these British marine engines; in a voyage occupying 450 hours the steam was expanded during 388 hours, at what is termed in this journal two-eigth stroke, but which from diagram now before us of that engine was three-sixteenth parts only, the remaining 62 hours mostly three-eighth parts of stroke, and of which only 18 hours extend to five-eighth stroke; and we have the fullest assurance the steam in the Great Western was no better employed, as the engines in that vessel are equally insufficient for a better application of steam.

The full and uninterrupted use of expansive steam, with its various advantages being impracticable in these vessels from the disproportion of their engines, is from necessity confined to the paltry purpose of saving an inconsiderable quantity of fuel in unfavorable weather alone. How effectually and profitably may these engines be improved, or how certainly and easily be surpassed.

Thus, then, may another shining light, another learned theorist be farther instructed by the mechanics he so ignorantly attempted to mislead when he so profoundly and learnedly proved the impossibility of navigating the Atlantic by steam; which we, mechanics only as we are, mere dust, are about to prove, has as yet, though so surprising to the intellectual doctor, been but tardily and imperfectly accomplished. A consideration of this diagram will render evident another and considerable advantage in the application of expansive steam, unnoticed by the visionary, unexpected by the practical, but which in large engines becomes of considerable amount by the superior vacuum obtained when steam is greatly expanded; for in this diagram the better vacuum increases the steam pressure when the steam is cut off at one-third stroke a full one-fifteenth part more than when compared with steam at full stroke; hence alone there is one-fifteenth part

additional power to be gained, which is now lost in these engines, in addition to that great gain from the employment of expansive steam.

But the great, the incalculable information contained in and derived from the diagram, is the full proof of that most desirable fact, that the full efficiency of steam is to be obtained from the expansion of low steam; hence we shall find the unlimited and inestimable advantages of steam may be obtained without its horrors and indescribable afflictions, and which are the more dreadful and disgraceful because the use of high steam is as unprofitable as inhuman.—*American Repertory.*

ADVANTAGES OF COMPRESSED PEAT. By Alexander S. Byrne.

(Continued from page 248.)

The preceding paper shows the value of peat in the manufacture of iron; but it may be profitably used for other important purposes.

Fuel.—It is of great value as fuel for furnaces and firing of every description, more especially so when coked and mixed with coal, or coal tar, or resin, pitch, and such like substances. Mr. Charles Williams, managing director to the Dublin Steam Navigation Company, a gentleman of experience and practical information, recommends a mixture of peat coke and resin for steam vessels. From his statement printed in the Transactions of Civil Engineers, London, it appears that one ton of resin fuel, (i. e. peat coke and resin) thrown in front of a coal fire is equal to three tons of coal.

For every description of firing, peat coke is invaluable. Its freedom from injurious and unpleasant exhalations, its durability and extreme brilliancy, are among its chief recommendations. What is so cheering as a brilliant fire! Of domestic comforts it is certainly one of the chief. For such purposes peat fires are unequaled. They are beautiful and pleasant, affording an *intense* heat, and a pure white and yellow flame, not surpassed by the finest coal.

Coking.—This is accomplished by means of heat. There are several modes of coking compressed peat: in every instance atmospheric air is excluded, and passages left for the volatile products to escape, as explained under the head *Pyroligneous Acid.* Some employ large brick chambers, with a hole at the top, a door at the side, and gutters at the bottom for the tar to escape: others form piles of various shapes, and cover them with loam, to screen the burning heap from a too free access of the atmosphere, which would otherwise consume it entirely. In some districts, large coking ovens are preferred; in others, a sort of iron hood; and in others, the use of large iron retorts. In every instance it is important that the process be conducted as uniformly as possible; that the escapes for tar and gaseous products be perfectly free; and that the mass undergoing carbonization be so distributed that the *whole* be acted on at the same time. Charcoal obtained by the action of rapid fire is always inferior to that obtained by slow calcination in pyramidal piles.

For softening steel plates, charcoal from turf moss is equal to the hardest oak; for the production of gunpowder, many varieties are superior to dogwood and alder, and for crayons it is equal to the finest willow. Much, however, depends on the mode in which it is burnt.

Gas.—Peat is very valuable for the production of gas. We have made considerable quantities in England and in Ireland. Prof. Maugham, of the Polytechnic Institution, London, one of the first practical chemists in that city, was induced to examine the subject, in consequence of our experiments in Ireland, and he has announced his opinion that peat may be so employed to considerable advantage. It has been severely and advantageously tested upon a large scale in Dublin, Paris, and Plymouth. Some

kinds of peat (top surface) yield three times as much gas as coal; but as a general rule it does not yield more than Wigan or New Castle coal: it is, however, far superior in brilliancy and power.

There was an objection to this gas, which for a considerable time destroyed all hope of rendering it useful, and severely injured the works erected for its production. In the distillation, an impalpable powder came over with the gas, which washing and re-washing would not remove, and it eventually deposited itself in the pipes and in the holes of the burners, and stopped them up. To remedy this evil, it occurred to us to use oil in the purifiers instead of water, which, we are happy to add, answered to the fullest extent. We have also found that oil acts as an excellent purifier for every kind of gas, and greatly improves its quality. The expense is trifling, as the oil when boiled becemes clear, and leaves all impurities at the bottom. Gas passed through *boiling* oil is still better. When mixed with coal in equal quantities, and calcined in the same retort, the peat at the bottom and coal on the top, the coke and gaseous products are superior to those obtained from the finest coal. The brilliant appearance of peat gas, and its *intense heat*, has been matter of surprise to those engaged in its production. Persons unacquainted with the secrets of a gas-work have urged as a reason against the use of peat gas, that it burns away in less time than gas from coal. In answer to this objection we would observe, that it is not true from a pure top-surface peat, but only of the lower beds; and being more brilliant, a less quantity will give as much light: also, that twice as much peat can be distilled in the same space of time; consequently, *twice as much coke can be obtained*, and at the same expense. Coke is considered *the most valuable* product in a gas-work.

Pyroligneous Acid.—When subjected to decomposition by fire, peat gives off condensible acetic vapors; its elements being separated by the action of heat, and reunited in another order, produce compounds which did not exist before. The proportions of these products differ in the same substances, according to the degree of heat applied, and the skill with which the operation has been conducted. The quantity of crude acid produced from turf-moss, and peat collected from the top surface, is very great.

For this purpose, the apparatus used in the manufacture of coal gas, or wood vinegar, may properly be employed. This consists of large air-tight cylinders, condensers, purifiers, stills, &c. The compressed peat, well crushed and broken, is to be put into retorts, their doors having been closed and luted with clay. Each door has a small vent, capable of being closed by a stopper or valve. The use of this vent is to allow the volatile products which are given off during calcination to escape; and the use of the stopper is to close the vent so soon as the calcining matter ceases to give out such vapors; or supposing, as is usual, another vent to be in the upper part of the retort, then it allows the operator to watch the process of calcination. Within each retort passes a rod, revolving upon its two extremities as points; the one end resting on the farther extremity of the retort, and the other in a hole in the stopper, capable of being closed by a cap. This rod has at one end a circular plate; and at equal distances along its length are fixed fans or spokes, perpendicular to the axis of the retort. The use of this apparatus is to stir and divide the matter while in calcination; and it does this when the stopper is removed, and a key is inserted into the rod, and turned round, causing of course the rod with its fans to revolve on its axis. The use of the round plate is, when the matter is perfectly calcined and the door is removed, to draw it forward, and rake it out with as little delay as possible into proper recipients placed in front.

The retorts should be heated to a pale cherry red before they are filled; and as soon as they are rendered air-tight by the closing of the doors, the process of decomposition begins, and the volatile products, consisting of gases, vegetable tar, and pyroligneous acid, being separated, pass off through an aperture in the top of a retort, to which pipes are attached, leading into condensers: these pipes are generally *wormed*, and inclosed by a stream of cold water. The gases may be purified, and collected in a gasometer to be burned, or turned off by means of a pipe into the fireplace. The condensed liquors are then allowed to settle: the vegetable tar falls to the botton, and the crude liquor is separated by decantation from the empyreumatic oil associated with it, and re-distilled in the ordinary way. The odor peculiar to this acid may be easily removed by agitating it with oil, and distilling it with sub-carbonate of potash and animal charcoal: or the vapors which pass over, during distillation, may be purified with greater effect by passing them through oil.

It is to be observed that the volatile matter which is allowed to escape during calcination is all valuable. The tar is useful as a varnish; or being subjected to distillation by itself, it affords crude pyro-acetic spirit, naphtha, kreosote, &c. The gases may be employed for illumination; and the crude acid may be employed for preparing acetate of iron, acetate of alumina, and acetate of lime (used in calico printing;) or it may be used for the production of pure acetic acid, and the best household vinegar. The charcoal which remains in the retort is superior to wood charcoal, and may be used as fuel.

Roads, Pavements, &c.—Peat does not answer alone for these purposes, being of a pulpy nature when wet, and too easily pulverized; but when combined with an artificial asphaltum, composed of carbonate of lime and coal tar, it forms a solid and elastic road, superior in many respects to wood or native asphaltum, and presenting a surface which in all seasons affords good footing for cattle. The tendency of this artificial asphaltum to crack and break is counteracted by the strong fibre of the turf, which, if added to the chalk and tar while warm, acts as a *binder* when the mass is cooled, and obviates its brittleness. In this respect peat is analogous to hair in mortar.

For Cabinet and Ornamental work, it is only necessary to use the peat when warm. It may then be moulded to any form, and afterwards hardened in alum water, varnished, or covered with metalic solution, to render it impervious to water. When properly compressed, it can be worked in the same manner as wood, and is capable of sustaining a very high polish.

Having said so much on the properties and uses of peat in compressed and other states, we would remark, in conclusion, that where density is not a considerable object, peat can be advantageously worked in good brick machines, provided the superabundant water is evaporated, and the operation completed, while the peat is warm.

We sincerely hope that these observations may induce our friends in Ireland to provide suitable employment for the laboring poor of that country, and that her desolate moors may soon become, as was once said of them, "mines above ground."—*American Repertory.*

The Thames Tunnel.—The famous Thames tunnel, as is well known, is now near completion. The mode of egress, for foot passengers, is to be a spiral staircase. The carriage way is to be spiral, and two hundred feet in diameter. The gradients of the road will be about one foot in twenty-five, forming an inclination by no means inconveniently steep.

SIXTH SEMI-ANNUAL REPORT OF THE ENGINEER OF THE CENTRAL RAILROAD AND BANKING COMPANY OF GEORGIA, TO THE PRESIDENT AND STOCKHOLDERS.

In making the present semi-annual report of the operations of this department, and the condition of the work under its charge, I take great pleasure in announcing to the stockholders, the final and complete location of the road to the Ocmulgee river at Macon. The work has been one of great labor, and has occupied the time and exertions of a party of Engineers who have been engaged in the special service for nearly four years. The complex topography of the country through which the upper portion of the line runs, and the various routes that presented claims to an examination, have rendered these protracted and laborious surveys indispensable.

Four different routes have been surveyed between the Oconee and Ocmulgee rivers; and each successive survey has shown a line improved on the previous one; and it is confidently believed we have at length selected one that could not be much further improved. We have been able to keep our planes within the maximum inclination of 30 feet per mile, and have no curves on a shorter radius than 2000 feet.

The excavation and embankment are reduced to a much smaller quantity than we at first even hoped for; and the character of the material for the most part, is such as to allow its removal without the aid of the pick or even the plough. Pine timber of the best quality, abounds throughout the whole route, and although we shall encounter no rock in our excavation, it can be obtained at reasonable distances from the points where it will be required for masonry.

To the untiring perseverance, good judgment, and scientific qualifications of my principal assistant, Mr. Franklin P. Holcomb, I take pleasure in ascribing the credit which is eminently due him, for the selection of so favorable a route; his duties have always been performed with cheerfulness, and in the most thorough manner. His labors have been faithfully seconded by the several gentlemen composing his party, who have also just claims to my approbation.

In my previous reports, I have described the route to the Oconee river; it will be borne in mind that the line approaches the Oconee by the valley of Sandhill creek. This creek joins with Buffalo creek, as it enters the Oconee swamp, and our line in passing through the river swamp on the east side, crosses several lagoons and branches of Buffalo creek. The distance from the high ground to the river, is little short of a mile.—This is the lowest part of the river swamp, and the road will be passed over it, on truss work, founded on piles, for about a distance of 4000 feet, to the bank of the river.

The width of the river at the time the line was located, was 140 feet, and the depth, in the deepest part, about 8 feet; this however was at its lowest stage. The plan adopted for the main bridge, is the lattice plan, invented by Mr. Town,—the length of the bridge two hundred and fifty feet, to be supported by two abutments and one pier, of stone; the bottom of the bridge will be elevated 22 feet above the surface of the water at its lowest stage, and the grade of the road will be five feet above the height of the great freshet in June last. On the west side of the river, the swamp is about two miles in width; this will be crossed by an embankment, averaging about fifteen feet in height, with an opening near the middle of 1000 feet of truss work, making in all, a water-way of about one mile, to vent he water of the Oconee river.

It is a very fortunate circumstance, that we had such an indication as the last great freshet to guide us, in fixing the grades of our road across this river, and determining the character of the structure of that portion of the work. The celebrated Yazoo freshet, would otherwise have been taken as the high water mark and that did not reach the height of this last flood, by nearly five feet, at that point.

Having thus passed the Oconee river, we find ourselves near the mouth of Commissioner's creek, which discharges itself into the river about a mile and a half below our line; about four miles from the river, the line crosses to the south side of the creek, and follows its valley for the distance of twenty-six miles; then leaving it we pass with a cut of thirty-one feet (which is the highest point of land the road crosses, being about 500 feet above tide water) into a prong of Big Sandy creek—following this stream, with a descending grade, about two miles, we cross it, and take another branch of the same creek, which we keep for about the same distance; thence across the main branch of Sandy creek; by a small branch we ascend to the summit between the Oconee and Ocmulgee rivers—here we have a short cut of thirty-two feet depth at the highest point; falling into a branch of Swift creek, which we follow a mile and a half, then cross the main creek; and taking and taking another branch of Swift creek, we reach Boggy branch, which leads us to the valley of the Ocmulgee. In crossing from Swift creek to Boggy branch, we encounter the deepest cutting on the line, which at its greatest depth is forty-one feet. After reaching the river valley, about three miles below the City of Macon, we keep along the low grounds, and enter the river swamp near the great mound; the line crosses the river, about half a mile below the bridge, and terminates on the flats at the foot of Cherry street in Macon,—the whole distance from this city being 190 miles, 3900 feet.

In the event of terminating the road on the east side of the river, we should deflect by a curve to the right, commencing near the mound; and run along parallel with the river, to such spot as might be selected for a depot.

For a distance of 25 miles from the Oconee swamp, the work is for the most part light, with occasional short cuts and fills; the remainder of the distance about 16 miles is rather heavy, compared with other parts of the line. I have taken the precaution to have wells dugs in the principal cuts, to ascertain the quality of the material to be excavated, and find it to be of the most favorable character. The cuts are composed of a mixture of sand and clay, easily removed by the shovel.

On the subject of the termination of the road at Macon I am of opinion that the interest of the company, and more especially that of the city of Macon, would be best promoted by crossing the river.

It appears to me that the free and constant intercourse which will necessarily be kept up by the business community, with the depot, requires the removal, as far as possible, of every obsticle to such intercourse; and that the intervention of the river, would be, in some degree, a hindrance to the transaction of business; but more especially in the event of the destruction of the present bridge by fire or otherwise. Should the road be carried across the river, the bridge would of course be so constructed as to be used exclusively for the passage of the trains, and would therefore be no injury to the present one, in the matter of travel. There will be no difficulty in selecting a favorable site for a depot in either case. The additional expense to the company by crossing will, be about $30,000.

The grading of the whole of the line not under contract is advertised for letting at Milledgeville, on the 5th day of next month; and I flatter myself that we shall have no difficulty in putting it under contract; should this be

done I think we shall be able to reach Macon with the superstructure by 1st January, 1843.

The work has progressed steadily on the grading contracts for the last six months; the total distance graded is now about 143 miles and the superstructure is completed 126 miles

The 2000 tons of iron last ordered, has all been received, and will be sufficient to extend the track to the distance of 139 miles. Our trains are now running regularly to Hardwick's, 122 miles from the city, and although the cotton crop has been unusually late, and very short, our business has been, during the last six months, nearly double the amount of the same period last year.

Receipts of the road for 12 *months, ending* 31*st Oct.* 1840.

Up freight.	Down freight.	Mail.	Passengers. No.	Passengers. Amount.	Total.
$44,425 09	$34,817 74	$3,792 32	11088	$30.792 36	$113,827 51

[The above is exclusive of the transportation of iron and other materials to a large amount, for the uses of the road.]

The expenses of the transportation department for the same time, have been	$23,276 16
Repairs of road,	$11.075 31
Total,	$34,351 47

The average distance in operation, during the past year being about one hundred and ten miles—the cost of repairs has therefore been about one hundred dollars per mile.

The opinion has generally prevailed, that a railroad, to be profitable to its stockholders, must have a large amount of travel—that the only source of profit is in the transportation of passengers, and that as a general rule, the freighting of heavy commodities, yields little or no profit to the company.

The experience thus far, on our road, demonstrates in the most satisfactory manner, the error of this opinion. It will be perceived by the above statement, that our freighting business has more than doubled the amount of that of passengers, and mail—and this has been done under the disadvantage of having but one train for both purposes, consequently keeping up a speed altogether too great for the most advantageous transportation of freight. I have no doubt that freight trains run separately from the passenger trains, with full loads, and at a velocity not exceeding ten miles per hour, would yield as much profit per trip, to the company, as passenger trains carrying fifty passengers each way.

The present terminus of our road, is by the wagon route, 70 miles from the city of Macon. Notwithstanding this long portage over a bad road, we have had, during the present season, nearly all the freight for that city. There has been an average of 200 wagons, running during the last three months to and from the depot. I am confident that the merchants will find it to their advantage to abandon altogether the steamboat business, on the Oconee and Ocmulgee rivers

Our machinery and motive power department, is now as complete as the necessities of the road require. Since my last report, a locomotive engine, from the manufactory of Messrs Rogers, Ketchum and Grosvenor (the Oconee) has been added to our motive power, making our whole number eight. The superstructure of the road continues to maintain its grade and allignment, and the small amount expended in repairs, as before stated, has kept it in good repair. Some of the timbers first laid on the lower portion of

the line, have decayed, and we have, during the past year replaced them. Contracts have been made for the delivery of timber at different points along the oldest parts of the road, for the occasional renewal of such pieces as may be decayed.

The operations of the road have thus far been conducted *without the occurrence of a single accident resulting in personal injury to any one.*

Should we succeed in letting the grading, as we have reason to expect we shall, on the 5th of December we shall, be able to complete the road, without receiving aid from abroad in the way of pecuniary means. It will be a subject of just pride to the friends of the institution should an undertaking of such magnitude be carried through with their own resources, unaided by foreign capital. I take pleasure in congratulating them on the prospect of such a result.

Respectfully submitted,
L. O. Reynolds, Chief engineer.

Steam Navigation.— It is remarkable that this science, did not for many years after its invention and application, make such progress as one would conceive its palpable merits and advantages entitled it to. It was not until the year 1828 that the navy of England possessed a single steam vessel, and in 1835 we had only twenty one of the aggregate of 3000 horse-power. From that date this species of force has multiplied greatly, and now amounts to nearly eighty, under the pendant of 11,000 or 12,000 horse power. France has done her best to keep pace with us, having between forty and fifty steam vessels afloat and building, but none equipped of more than 220 horse power. By arming her packets she makes considerable display; but her resources for increasing this force on emergency are feeble as compared with our own, for the mercantile steam tonnage of the United Kingdom, progressing as it is in a prodigious ratio, presents the most stupendous element of naval power (by giving facility of operations) that the world has ever witnessed. We recollect when the expedition for the attack of Copenhagen was projected, in 1807—the completest and best appointed expedition that ever England sent forth—although preparations were commenced in March, it was not until so late in the season as the 26th of July that the first division of the fleet sailed from Yarmouth roads, leaving but little time to execute the objects of the campaign before the winter set in. Now, England at this moment possesses such an amount of steam tonnage, (according to the last official returns published 810 vessels, 157,840 tons, 63,350 horse power,) that a portion of it could convey the necessary troops, with all the usual appandages, and tow a squadron of ships of-war to the scene of action, in less than one quarter of the time occupied in the former expedition, should circumstances ever render it necessary for us to occupy the island of Zealand, or any post in the Baltic. The fact is that steam navigation, not only as directly applied to vessels-of-war, but in aid of combined expeditions for sudden descents upon different points, enables the country possessing it in the greatest force to harass an enemy's coast with a small but well appointed army, and to carry destruction to every town and village within a dozen miles of the sea, unless they are regularly fortified and garrisoned, or covered by large bodies of troops. It is stated by an old author, that "in the year 1647 the Dutch with a fleet and but 400 men on board, alarmed the whole coast of France, and obliged the French king to keep near 100,000 men upon the maratime coast, as not knowing where theywould fix."

If such was the case with vessels when movements were dependent on

winds and tides, and whose operations were under such circumstances necessarily slow, how much more so it will be with the aid of steam, when, by this means, vessels of light draught, heavily armed, not a boat will be permitted to pass out of gunshot of the shore, nor a harbor left open for egress or ingress any day in the year.—*London Naval and Military Gaz.*

Armed Steam Craft for the Lakes.—A correspondent of the Cleveland Herald, writing from Chippeway, U. C. says:

I have been permitted to visit Her Majesty's steamer, building at this place. She is called the *Minos*, in honor of the first King of Crete, who, according to heathen mythology, was after death promoted to the rank of *chief fireman* in the regions *de'l Enfer!*

She is 148 feet on deck, and registers 400 tons, and is built in every respect a "man of war." She is of great strength, her timbers being placed close together, are caulked and pitched before planking, so that in the event of starting a butt, she would not leak; a very desirable object in armed vessels. On the inside, parallel bars of iron are let into the timbers the entire length of the boat, and placed six or eight inches apart. This does not add materially to her strength, but renders her almost shot proof. Her planks are five inches and her sealing three inches thick, making her entire thickness about twenty-two inches of solid timbers.

She is fitted with two 45 horse power low pressure beam engines, from the manufactury of the Messrs. Ward, Montreal, which are placed entirely below deck, on the plan of the Atlantic steamers, and are beyond the reach of external injury; but they are, in my opinion, of too small a calibre for so heavy a boat.

The engines are supported by iron frames resting upon large fore and aft timbers, placed on either side of the kelson, which are securely bolted and fastened to the deck frame of the boat, and will, instead of weakening the boat, add greatly to her strength. The cylinders are 26 inches in diameter, with four feet and a half stroke, placed upright in the usual manner, but in place of one working beam to each engine playing above the cylinders, as is customary, they have two, *reversed*—one each side of the cylinder, and moving close to the floor of the boat. The piston rods act upon a cross head, as in the common square engine; but the connecting rods, instead of leading directly to the cranks, are fastened to one end of the working beams below, and through them transmit the power by means of other connecting rods, to another cross head which is attached to the cranks; thus giving regular and continued motion to the entire machine. The grates and boilers are arranged expressly for burning bituminous coal, and her "bunkers" will contain from 10 to 1200 bushels.

The magazine occupies all the after part of the hold, under the cabins of the officers, and is in as secure a place as there is about the ship, being below the reach of shot, and out of the way of fire.

The *Minos* is schooner rigged, and shows a clean deck fore and aft; and were it not for her funnel and wheel-houses, would look like a large schooner, as she has no guards or upper works of any kind. She is expected to mount eighteen pound carronades and two mortars for shells in case of a bombardment.

The part of the vessel forward of the engines is fitted as a mess room for the "people," and is a very comfortable place, having short tables for each mess projecting from the sides of the boat, and shelves and lockers in abundance for accommodation of their traps. The main hold is underneath the "people's" mess, and will contain abundant room for stores for a long cruise.